POPULAR SCIENCE

FEBRUARY

15 CENTS

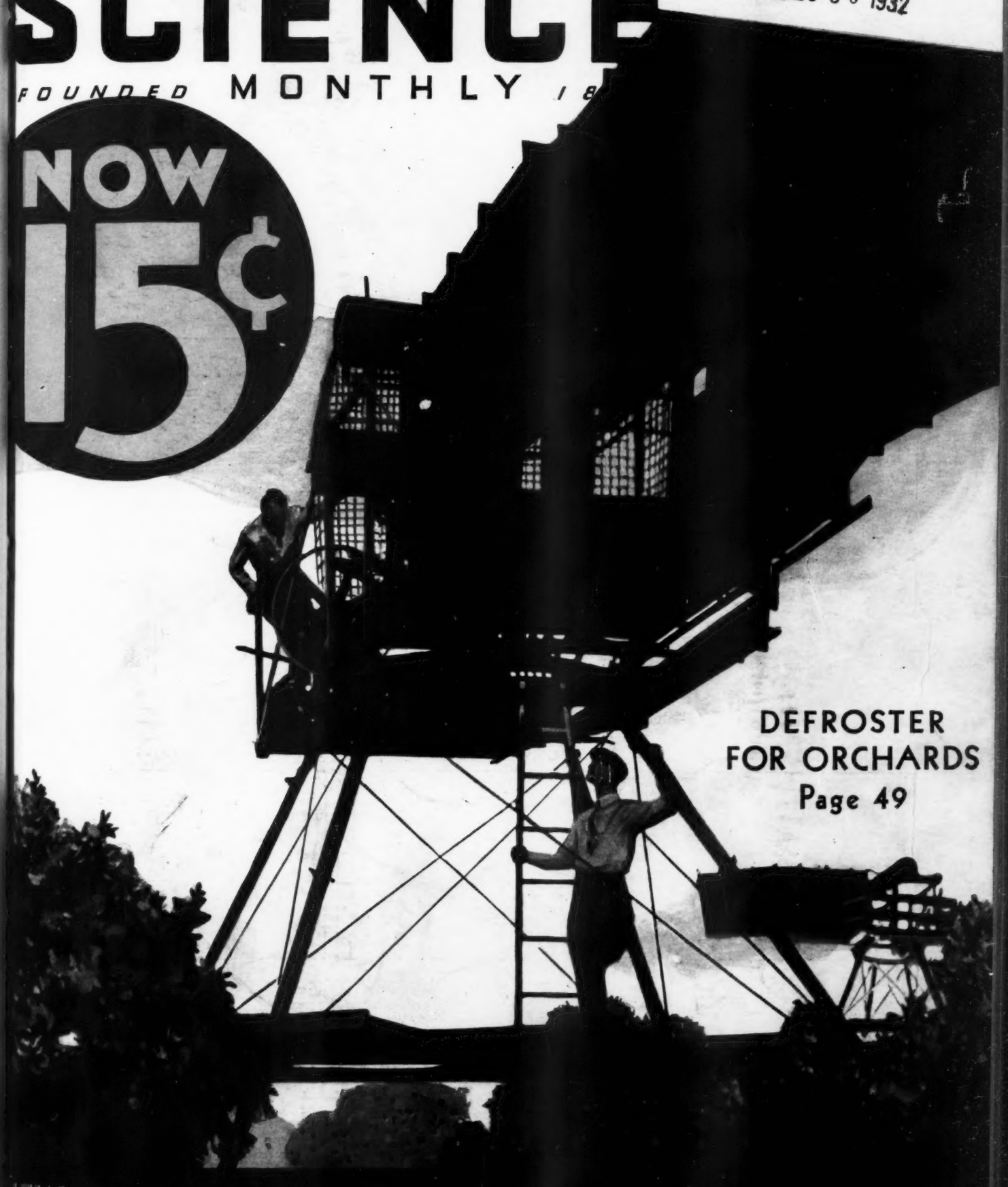
20 CENTS IN CANADA

PERIODICAL
GENERAL LIBRARY
OF MICH.

DEC 30 1932

FOUNDED MONTHLY 18

NOW 15¢



DEFROSTER FOR ORCHARDS
Page 49

NEW INVENTIONS MECHANICS MONEY MAKING IDEAS

...BUT THE JOKE WAS ON *HIM!*... by Timmins

THESE LIFEBUOY ADS. AMUSE ME. I ALWAYS READ THEM — BUT I CAN'T BELIEVE SO MANY PEOPLE HAVE "B.O."
YOU'RE WRONG. "B.O." IS A COMMON FAULT AND CAN WRECK A MAN'S HAPPINESS. I KNOW THAT ONLY TOO WELL
I WAS IN LOVE WITH A CHARMING GIRL, SHE SEEMED TO LIKE ME — YET SHE TURNED ME DOWN. TOO LATE I DISCOVERED WHY... I HAD BEEN CARELESS ABOUT "B.O."
I TELL YOU THIS BECAUSE I DON'T WANT YOU TO MAKE THE SAME MISTAKE I DID
YOU MEAN... I'M GUILTY SOMETIMES? THOSE "B.O." ADS. I LAUGHED AT — IS THE JOKE ON *ME*? IS THAT WHY EDNA IS OFTEN SO COOL TO ME?

MY ADVICE IS — PLAY SAFE WITH "B.O."! CHANGE TO LIFEBUOY
"B.O." GONE — *everything rosy!*
WE'RE GOING TO BE THE HAPPIEST COUPLE IN THE WORLD, EDNA
ISN'T IT *FUN* GETTING THINGS FOR OUR OWN HOME!

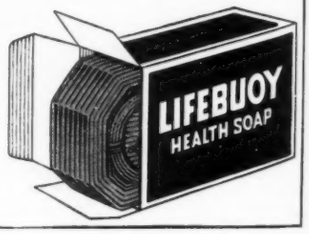
Get the facts STRAIGHT about "B.O."

(body odor)

EVERY normal person perspires. Pores give off a *quart* of odor-causing waste daily. Stuffy, overheated rooms increase the danger of offending. Play safe—bathe regularly with Lifebuoy. Its pleasant, quickly-vanishing hygienic scent tells you, "Here is no ordinary toilet soap!" Lifebuoy gives *extra* protection. Its creamy, abundant, penetrating lather purifies and *deodorizes* pores — effectively stops "B.O." (*body odor*). Helps protect health by removing germs from hands.

Great for the skin

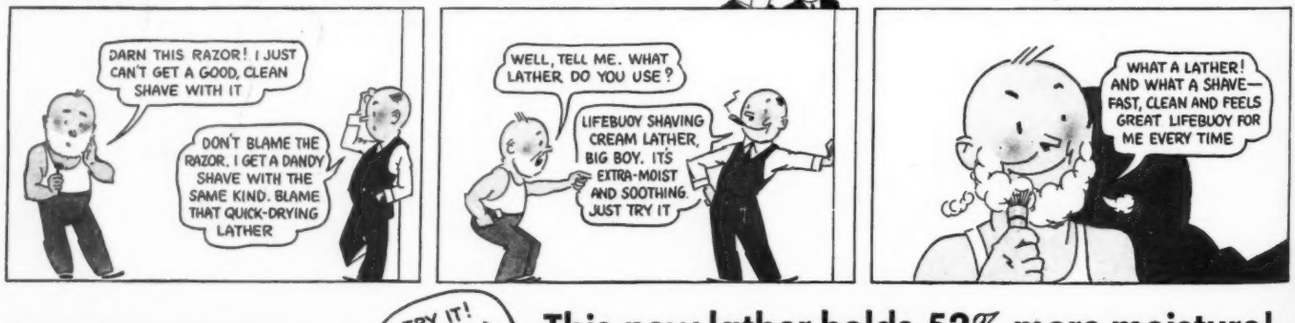
Massage Lifebuoy's bland, creamy lather well into the pores; then rinse. Do this nightly. Watch your skin clear and freshen—glow with new health! Adopt Lifebuoy today.

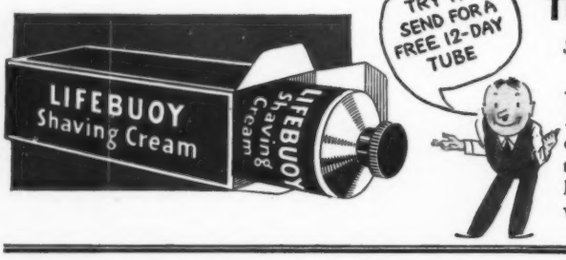


A PRODUCT OF LEVER BROTHERS CO.

A TIP FOR SHAVERS

by J.F. HART


DARN THIS RAZOR! I JUST CAN'T GET A GOOD, CLEAN SHAVE WITH IT
DON'T BLAME THE RAZOR. I GET A DANDY SHAVE WITH THE SAME KIND. BLAME THAT QUICK-DRYING LATHER
WELL, TELL ME. WHAT LATHER DO YOU USE?
LIFEBUOY SHAVING CREAM LATHER, BIG BOY. ITS EXTRA-MOIST AND SOOTHING. JUST TRY IT
WHAT A LATHER! AND WHAT A SHAVE— FAST, CLEAN AND FEELS GREAT LIFEBUOY FOR ME EVERY TIME

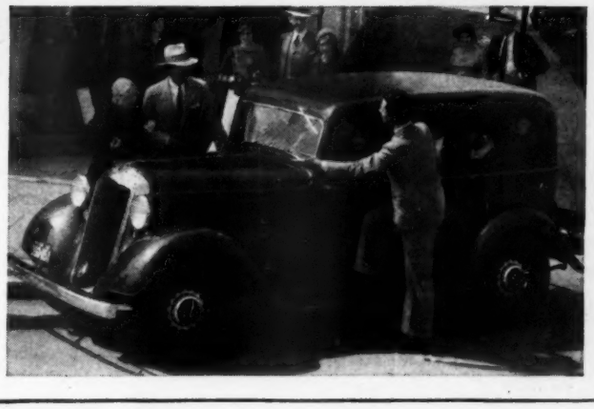


This new lather holds 52% more moisture!

Soaks beard extra soft — soothes skin — gives smoother, easier shaves

MEN, you can't expect anything but rough, spotty shaves with light, quick-drying lather. But, by laboratory tests, Lifebuoy Shaving Cream lather holds 52% more moisture. It *soaks* wiry whiskers *extra* soft—the razor whisks them off in a jiffy—you get the smoothest, cleanest shave ever. Lifebuoy soothes, protects the skin. Economical, too, a little makes so much lather. Get it at your druggist's. Or write for a free trial tube to Lever Bros. Co., Dept. A142, Cambridge, Mass. (*This offer good in U.S. and Canada only.*)

Look Under the Paint when you "Look at All Three"



Floating Power is one reason they're calling Plymouth Six— America's next Number One car!

YOU mechanically-minded men are particular about good looks in a car! But you *want a lot more!*

So you're just the men we like to talk to about the new Plymouth Six. You know what it means to have a 70-horsepower, six-cylinder motor in a car of this size!

You understand the value of Floating Power engine mountings—the value of mounting an engine on rubber and steel at *two* points instead of *four!* So it can rock gently on its axis . . . without *fighting the frame!*

You know the hydraulic principle—and how well it works in brakes. You know what makes a car *safe.* So you like Plymouth's safety-steel body, its rigid-X frame, its safety-glass windshield! We like you men to "Look at All Three"—because you're *picking Plymouth!*

IT'S A SIX AT $60 LESS THAN LAST YEAR

Business Coupe $495, Rumble Seat Coupe $545, 4-Door Sedan $575, Convertible Coupe $595; all prices f. o. b. factory. Convenient time-payments. Free-wheeling, rigid-X frame, easy-shift transmission. Automatic Clutch optional — $8.

PLYMOUTH SIX

SOLD BY 7,232 DESOTO, DODGE AND CHRYSLER DEALERS EVERYWHERE

RAYMOND J. BROWN, *Editor*
ARTHUR WAKELING, *Home Workshop Editor*
ALDEN P. ARMAGNAC, *Associate Editor*
SYDNEY OXBERRY, *Art Editor*

POPULAR SCIENCE

FOUNDED MONTHLY 1872

VOLUME 122 · NUMBER 2
15 Cents a Copy • $1.50 a Year
Published Monthly by
Popular Science Publishing Co., Inc.,
381 Fourth Ave., New York

TABLE of CONTENTS for FEBRUARY, 1933

First Transatlantic Air Line Links Two Continents 13
RENE LEONHARDT tells how regular ocean airplane service will start this spring

World's Biggest Stage Is Marvel of Mechanics 16
Our artist explains the workings of a masterpiece of theatrical engineering

Old Words Get New Meanings in Queer Trade Lingoes 28
Picturesque oddities of modern professional slang translated by GAYLORD JOHNSON

Safe Pain-Killing Drugs Bring New Era in Modern Surgery . . 32
FREDERIC DAMRAU, M. D., tells of wonders wrought by the latest anesthetics

Life of Atom Shown in Movies 35
Actors of the chemical underworld play star roles in new educational talkies

How the Biggest Ship Was Safely Launched 36
Inside facts about the fascinating operation of getting a huge liner afloat

Uncle Sam's Secret Agents Save Farmers from Crop Sharks . . . 38
WALTER E. BURTON discloses the drama behind the Government's produce reporting

New Products Hasten Prosperity's Return 40
Why experts believe a flood of inventions will end the depression

February, 1933. Vol. 122, No. 2. **Popular Science Monthly** is published monthly at 381 Fourth Avenue, New York, N. Y., by the Popular Science Publishing Co., Inc. A. L. Cole, President and Treasurer; R. C. Wilson, Vice President; John Nichols, Vice President; F. W. Briggs, Sec'y. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U. S. A.
Copyright, 1933, by the Popular Science Publishing Co., Inc.
Single copy, 15 cents (20 cents in Canada). Yearly subscriptions to United States and its possessions, $1.50; foreign countries, including Canada, $2. Subscribers must notify us of change of address four weeks in advance of the next publication date. Be sure to give both old and new address. The contents of this magazine must not be reprinted without permission. The editors are not responsible for unsolicited contributions, and cannot guarantee the return of such material or insure against its loss. Contributions not accompanied by sufficient postage will not be returned. In presenting numerous stories of new products of applied science, **Popular Science Monthly** does not underwrite the business methods of the individuals or concern producing them. The use of **Popular Science Monthly** articles for stock-selling schemes is never authorized.

FEATURES AND DEPARTMENTS

Our Readers Say— 10
Microscope Creates New Worlds . 46
Chemicals You Can Make . . . 56
Stunts Illustrate Natural Laws . 58
Homemade Test Lamp for Radio 59
Simple Amateur Radio Phone . . 60
How Detector Helps Radio Work 61
Fixing Faulty Car Brakes . . . 62
The Home Workshop 63
Short Cuts for Car Owners . . 72
Flashlights Aid Picture-Taking . 78

Cover Design by EDGAR F. WITTMACK

AUTOMOBILES

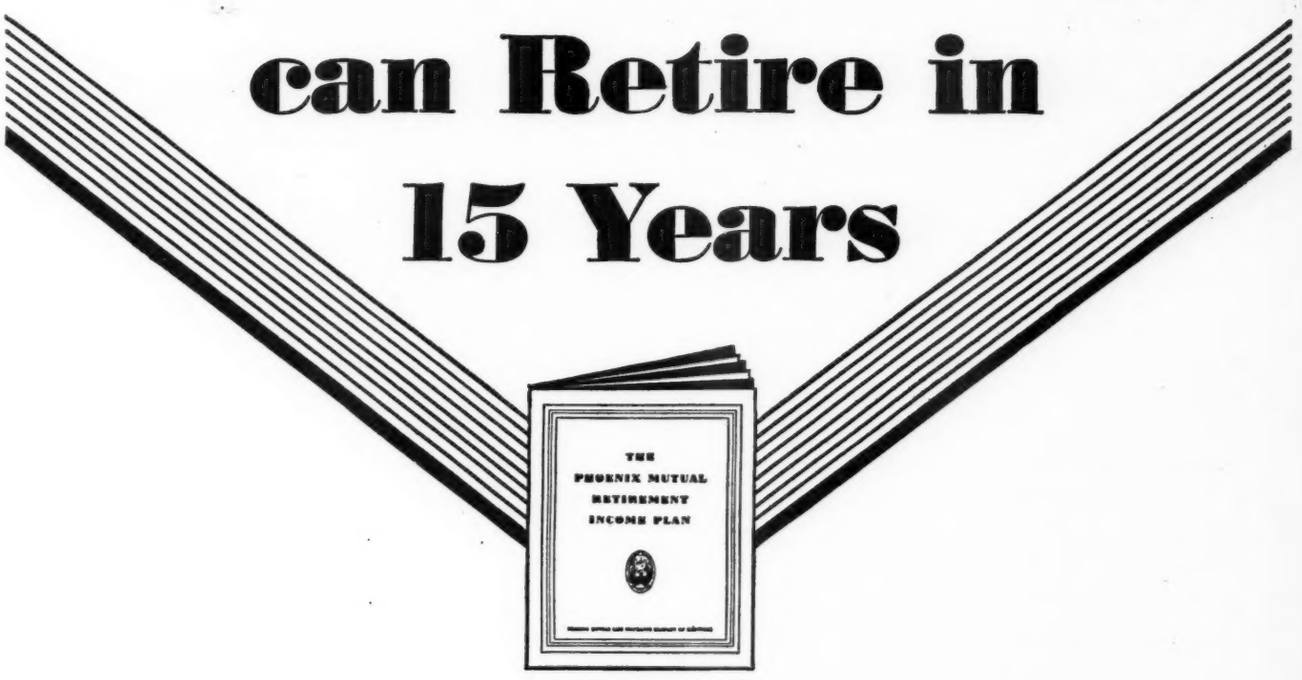
Cigarette Case for Auto 18
Device Renews Worn Pistons . 24
A Two-Way Truck 26
Foils the Car Thief 42
Tiny Car Has Rubber "Motor" 48
Elephant Serves Motorist . . . 49
Car Tested on Rollers 50
New Spark Plug Tool 50
Life-Saver on Big Bus 51
Car Tests Three Fuels 51
50 Instruments Help Run Car . 53
Dual Voltage Battery 53

AVIATION

Strange Motor for New Plane . 19

(Continued on page 4)

How a Man of 40 can Retire in 15 Years



IT makes no difference if your carefully laid plans for saving have been upset by the depression. It makes no difference if you are worth half as much today as you were in 1929.

Now, by merely following a simple, definite Retirement Income Plan, *you can arrange to quit work forever fifteen years from today with a monthly income guaranteed to you for life.* Not only that, but if something should happen to you *before* that time, we would pay your wife a monthly income for life. Or, if you should be disabled, and were unable to continue your payments, we would *make them for you*, and pay you a disability income *besides!*

$250 a Month beginning at age 55

Suppose you decide to retire on $250 a month beginning at age 55. Here is what you get:

1. A check for $250 when you reach 55 and a check for $250 every month thereafter as long as you live.

2. A life income for your wife if you die before age 55.

3. A monthly disability income for yourself if before retirement age serious illness or accident stops your earning power for good.

It sounds too good to be true. But it isn't. There are no "catches" in it, for the plan is guaranteed by an 80-year-old company with $600,000,000 insurance in force. If you are in good physical trim, and are willing to lay aside a modest portion of your income every month, you can have freedom from money worries and you can have all the joys of recreation or travel when the time comes at which every man wants them most.

The Plan is not limited to men of 40. You may be older or younger. The income is not limited to $250 a month. It can be more or less. And you can retire at any of the following ages you wish: 55, 60, 65, or 70.

How much does it cost? When we know your exact age, we shall be glad to tell you. In the long run, the Plan will probably cost nothing, because, in most cases, every cent and more comes back to you at retirement age.

Write your date of birth in the coupon below and mail it today. You will receive, without cost or obligation, a copy of the interesting illustrated booklet shown above. It tells all about the new Phoenix Mutual Retirement Income Plan. Send for your copy of the booklet now. The coupon is for your convenience.

PHOENIX MUTUAL LIFE INSURANCE CO.
772 Elm St., Hartford, Conn.
Send me by mail, without obligation, your new book,
"THE PHOENIX MUTUAL RETIREMENT INCOME PLAN."

Name_____

Date of Birth_____

Business Address_____

Home Address_____

PHOENIX MUTUAL LIFE INSURANCE COMPANY

Home Office: Hartford, Conn. Established in 1851

Copyright 1932, P. M. L. I. Co.

POPULAR SCIENCE MONTHLY for FEBRUARY, 1933

(Continued from page 2)

Navy Gets Two-Purpose Planes 45
Liquid Air Helps Make Motors 50

ENGINEERING

Change Course of Big River . 22
Model of 1,400-foot Windmill . . 26
Superhighway Links Cities . . 26
Dishpans Light Work at Dam . 48

MODELS

Pocketknife Model of Liner . . 63
Scenic Effects for Railway . . . 78
Fiber Board Reduces Noise . . 78
Telegraph Pole Insulators . . . 78
A Two-Circuit Rheostat 78
Making Ship Model Ladders . . 87
Armament for Our U.S.S. *Texas* 88
Ruling Pen Aids Model Making . 95

NEW DEVICES FOR THE HOME

Invisible Gas Heater 54
Cutter Opens Paper Cartons . . 54
Portable Bridge Table 54
Automatic Defroster 54
Perfumes Dresser Drawers . . . 54
Time for the Medicine 54
Electric Wax Candles 54
Divan and Two Beds in One . . 55
Tooth Paste Tube Holder . . . 55
Colander Part of Stew Pot . . . 55
Protects Bridge Table 55
Ash Tray and Tobacco Holder . 55
Clock without Hands 55
A Blanket of Soapsuds 55

NEW PROCESSES AND INVENTIONS

Frame Teaches Swimming . . . 18
New Indoor Golf Tee 18
Reel Part of Fishpole 19
Theatrical Scenery in Kit . . . 20
Windmill Defies Hurricanes . . 20
High Speed Railway Buses . . . 21
Screws Whirl on Snow Plow . . 24
This Boat Can Crawl on Land . 26
Mobile Life Preserver 27
New Jack Pushes Tree Down . 27
Saw Cuts Off Finger Ring . . . 27
Cylinder Dives for Treasure . . 43
Pipe Shoots Real Bullets . . . 44
Holder Encloses Cigarette . . 44
Skid Chains for Shoes 48
New Bicycle Has Odd Design . 49
Folding Pipe for Smokers . . . 50
Novel Phonograph Needle . . . 50
Sight for Archer's Bow 52
Cellophane Windows 53
Perforated Golf Club 53

PHOTOGRAPHY

Dots on Margin Identify Films . 76
A Pill-Box Timer 79
Camera Splits Sport Honors . . 25
Odd Lens Needs No Filter . . 43
Photos "Read" Burned Papers . 51
$100 for Family Group Photos . 78

RADIO

Eleven-Pound Radiophone . . . 18
Radio Controls Model Boat . . 24
Edison's Tube Works in Test . 44

UNUSUAL FACTS AND IDEAS

Looks Like Perpetual Motion . . 18
Cross-Eyes Now Cured by Pictures 19
Illustrated Lectures Given by Machine 19
Flagpole Moved at Busy Spot . 20
Metal Dishes for Explorer . . . 20
Making Mariners in College . . 23
Ferry Carries One at a Time . 24
Lures Mosquitoes to Death . . 25
Locomotive Like Box Car . . 27
Magnet Finds Lost Locomotive . 30
Flowers "Grown" for Movies . 31
Proposes Houses of Cotton . . 42
Dogs Now Noseprinted . . . 42
Transformer Inside Insulator . . 42
Odd Device Measures Eye . . . 42
Seek Secrets of Frost 44
Process Saves Newspapers . . 45
New Way to Serve Ice Cream . 45
Machine Measures Beauty . . . 48
His Xylophone Sells Pastry . . 48
Big Fans Protect Orchards . . 49
Tests Fireproofed Wood . . . 51
Guns Clean Cement Kilns . . . 52
Traps Cosmic Rays in Cellar . 52
One Man Handles Big Ladder . 52
Imitation Brick for Houses . . 53

FOR THE HOME OWNER

Door Stop from Tobacco Can . 66
Setting Ladder Against Pole . . 67
Attaching Tube to Faucet . . . 73
Tightening Hinge Pins 85

IDEAS FOR THE HANDY MAN

Rack Holds Metal Stock . . . 66
Raised Panels Made on Jig Saw . 66
Clamps Aid in Truing Rods . . 66
Child's Lamp Has Night Light . 67
Scraping Aquarium Walls . . . 67
Snowshoe Making Is Easy . . . 68
Ornamental Indoor Fountain . . 70
Kitchen Worktable Folds Flat . 73
Depth Gage for Circular Saw . . 73
Fittings for Your Ice Yacht . . 80
Repairing Harness Saves Money 83
Our Construction Kits 84
Clamping with Pinch Dogs . . . 86
Hinges Provide Toy Axles . . . 86
Sorting Tray from Egg Packing . 86

HINTS FOR THE MECHANIC

Sleeve Supports Taps in Lathe . 79
Keyway Cut on Drill Press . . 86
Transferring Blind Holes . . . 97
Holder Keeps Wire Taut . . . 97

In This Issue—Hundreds of Fascinating Articles Tell the Latest News of Laboratory Discoveries, Scientific Triumphs, and Amazing New Inventions

"Now we can advertise it"

Products are nearly always put on the market before they are advertised. Quite frequently, changes have to be made in an article before the public generally will accept it. Color, design, flavor—those are some of the things the public has to be consulted about. Sometimes a product won't sell at all and simply has to be discontinued. As soon as people show that they welcome an article, and as soon as all refinements and improvements have been added, then you could hear the manufacturer say, "Now we can advertise."

When you buy advertised goods, you may know they have gone through the experimental stages. You may be sure that the manufacturer knows they are right and that he is willing to stake his reputation on them. You may be confident that you are buying goods that have sold and that would continue to sell without any advertising at all. For advertising merely lets all of the people know—now—what considerable numbers would find out by word of mouth ten years from now.

Of course, advertising goes a step farther. Word of mouth hardly ever tells all the uses of a product. It often doesn't give the real reasons for its superiority. Advertising tells people all about a product and the numerous ways in which they can use it.

Let the advertisements be your guide. When the manufacturer says, "Now we can advertise it," you know that you can safely say, "Now we can buy it."

MEET OPPORTUNITY

OPPORTUNITY for well-trained people is greater today than ever before; changes are more frequent. Increased capacity to assume responsibility is sought, whether it be in the lowliest office job or a high diplomatic mission.

Universities are extending their facilities to meet the demand for practical, as well as for purely cultural education.

Columbia University offers home study instruction that resembles private tutoring in that everyone who enrolls is taught through personal correspondence by members of the regular University teaching staff.

Over 200 courses prepared specially for study at home offer to anyone anywhere who is capable of undertaking this work an opportunity to carry on his training under competent, interested University educators.

Whether your objective is economic advancement, keener appreciation of the arts and sciences, or greater social service, write without any feeling of obligation.

The success of thousands of home study students has proved the real value of this type of instruction.

A partial list of courses is given herewith. A bulletin showing the complete list including high school courses will be sent on request. If you will write us, we shall be glad to help you with your program of study.

COLUMBIA UNIVERSITY HOME STUDY COURSES

Accounting	Investments
Agriculture	Italian
American Government	Juvenile Story Writing
Applied Grammar	Latin
Banking	Library Service
Business Administration	Literature
Business English	Machine Design
Business Law	Magazine Article Writing
Business Organization	Marketing
Business Psychology	Mathematics
Chemistry	Music—Harmony
Child Psychology	Personnel Administration
Classics	Philosophy
Contemporary Novel	Physics
Corporation Finance	Playwriting
Drafting	Poetry
Economics	Psychology
English Composition	Public Health
English Literature	Public Speaking
Essay Writing	Real Estate
Fire Insurance	Religion
Foremanship	Secretarial Studies
French	Selling
Geometry	Short Story Writing
German	Sociology
Grammar	Spanish
Greek	Stenography
High School Courses	Typewriting
History	World Literature, Etc.
Interior Decoration	

FILL OUT AND MAIL THIS COUPON TODAY.

COLUMBIA UNIVERSITY, *Home Study Dept.*
15 Amsterdam Avenue, New York City

Please send me full information about Columbia University Home Study Courses. Pop. Sci. 2-33

Name .....

Street & Number .....

City ..... State .....

Occupation .....

List in the margin the courses in which you are interested.

What About ANNUITIES?

By LEON MEADOW, *Financial Editor*

BELOW is a letter received recently by this department. It brings up a question which we believe is general enough to be of interest to all readers of these columns.

Financial Editor,
Popular Science Monthly,
381 Fourth Ave., N. Y. C.

Dear Sir:

I follow your financial articles each month with interest, especially those devoted to life insurance problems. Have wanted for a long time to see something about life insurance annuities in these columns. I think it is a form of insurance about which people are particularly uninformed. I know I am.

Have you neglected writing about annuities on purpose? I mean do you consider them unwise or unsound for some reason? I would appreciate learning more about annuities, in what different forms they are sold and what their purpose is.

Sincerely yours,
Arthur Williams, Rivera, Ill.

If Mr. Williams is under the impression that I don't favor annuities, he is wrong. I think the subject is of sufficient general interest to warrant writing my reply in the form of an article.

• • •

TO BEGIN, let me correct an impression Mr. Williams may have given when he wrote "life insurance annuities." This phrase is somewhat misleading. Annuities, strictly speaking, do not fall under the head of life insurance, for the simple reason that they do not carry the *face-value* death benefit by which all life insurance contracts are identified.

First examination of this statement may lead the reader to believe that annuities, therefore, have nothing to do with life insurance, but should come within some other type of investment classification. The truth of it is that annuities are a combination of both, being *guaranteed* investment *incomes* based on a conservative rate of interest *plus* an extra factor based on special mortality tables, as derived from the past history of many thousands of policy holders of this type. This will perhaps be clearer as we describe the various forms of annuities and the examples best fitted to each form.

SINGLE PAYMENT ANNUITIES: This type of annuity guarantees the holder an income for life without return of balance of principal. Let me clarify that. The annuity must be bought outright and paid for in a single lump sum. Immediately thereafter, the holder receives an annual guaranteed income for the remainder of his life.

Suppose, for the sake of illustration, that a man at the age of sixty has at his disposal $30,000 worth of securities. He has no dependents to care for, and is anxious to retire. His investments, if they average the good yield of 5%, bring him $1,500 a year. But that's not enough. He needs $50 a week to maintain a scale of living that approaches the one he now enjoys. If he turns that $30,000 over to an insurance company and purchases an annuity for that sum, here's what happens. The insurance company will pay him $2,793.30 a year for the balance of his life. This is $54 a week.

HERE is what is meant by "without return of balance of principal": when he dies, the balance of his $30,000 principal, (or difference between principal and amount he has already received in annual income, assuming that there is a difference in his favor), remains with the insurance company, and does not go to any heirs he may have. On the other hand, of course, the man may live to be 80 years old. In which case he has already drawn in twenty years of annual income the sum of $56,286.00, which is almost twice as much as his original principal.

This type of annuity is also sold *with* a return of balance of principal, should the purchaser die prematurely. But naturally the income per year is less than in the above contract. Taking the same example, the man of sixty would receive $2,373.30 a year or about $46 a week. But, if he died at seventy, after receiving $23,733 in ten years of annual income, there would still be some $6,300 left for any dependent or beneficiary he might care to name.

From which it may be seen that the value of the first type is for the man with absolutely no dependents, but who has a strong need for maximum income while he lives. The second type is more desirable for the man who, while needing a larger income than could otherwise be obtained, also desires to leave something behind him.

The first type is likewise admirable for women affected by present financial conditions. A great many widows, left with sizable estates, now find themselves with greatly depleted incomes due to dividend and bond defaults. *(Continued on page 7)*

WHAT ABOUT ANNUITIES?

(Continued from page 6)

It becomes necessary to cut into the principal of the estate to maintain their scale of living. As this is done, the income decreases, and each year more principal is needed. It doesn't take long to exhaust both. An annuity, of the first type described, fits that situation perfectly.

GUARANTEED ENDOWMENT ANNUITY: This form differs from the Single Premium Annuity in that payments are made annually over a certain period of years, rather than in one lump sum. Guaranteed Endowment Annuity enables a man to start paying a stated amount each year until he decides to retire. Upon retirement he will be granted a guaranteed annual income for life, on the same basis as already described—that is, either with or without return of balance of principal.

FOR a concrete example, take a man of 35 who decides he would like to retire at 65. Actually, he is not bound by the company to stipulate and to hold to his retirement date. He may terminate his payments when desired, and the guaranteed income will be paid accordingly. In our case, however, he is going to continue his annual payments for the full thirty years. He sets the amount he can pay at $600 a year or about $11.50 a week. After thirty years, at sixty-five, he decides to retire and to begin drawing his annual income. He is then entitled to $34.00 *a month* for every $100 unit which he has paid annually. In other words, he receives $2,448 a year for the rest of his life. This is $47.00 a week—more than four times the weekly payments he has made! Should the man die before his retirement age, and during the period in which he is still making annual payments, the contract has a death benefit, in so much as its *cash value* is payable to heirs or beneficiaries. However, similar to all other annuity contracts, it has no *face-value* death benefit.

This contract is designed primarily for those who do not need additional life insurance protection, but who do wish to provide a *guaranteed* annual life income for themselves, beginning at a period when their earnings have decreased or ceased entirely, due to retirement. No physical examination is necessary.

One phase of Guaranteed Endowment Annuity has a partial relationship to life insurance. It is possible in the case we have taken for the man to discover that, for one reason or another, he needs more life insurance. He can accomplish this by switching the annuity to any form of life insurance he wishes. The insurance then becomes dated back to the time when the *annuity was issued* and the premium is based on that date. Due to the fact that the man has been carrying an annuity contract, the cash value is greater than it would be in a life insurance policy in force the same number of years. This adjustment is also made. The most common instance in which this transfer is made is among the "temporarily uninsurables." That is, people, who through some temporary physical condition, cannot qualify for life insurance. *(Continued on page 8)*

Follow the Direct Road to Success

Do you want a better position and a larger pay envelope? There is just one way to win success—be head and shoulders above your fellows by gaining a broader basic education. Mathematics is the basis of all education. Not a day passes in which you do not have to use mathematics in your work. Do you make your own calculations, or are you handicapped by your inability to do this work yourself? Here is the whole secret of success. This is why mathematics is taught in every school and college. A thorough knowledge of it makes clear so many things which are puzzling you today.

Do not let another day pass without doing something to improve your knowledge of mathematics. But how can you obtain this knowledge? By going back to school or college, or taking an expensive correspondence course? You need do neither!

At Last! Mathematics Self-Taught This Simple, Easy Way!

Now you can take advantage of this easy method which has been worked out by an expert for those who do not wish to give the time and money required by other methods of mathematical study. A very simple and extremely interesting group of books has been prepared for you by a man who has devoted his life to teaching practical men the fundamentals of this important subject.

MATHEMATICS FOR SELF STUDY

By J. E. Thompson, B.S. in E.E., A.M.
Dept. of Mathematics, Pratt Institute, Brooklyn

These books start right from the beginning with a review of arithmetic that gives you all special short-cuts and trick problems that save countless hours of your time and make you more valuable to yourself and your job. Then they go right into higher mathematics and show you how simple it is when an expert explains it for you. Don't let appearances fool you, mathematics is *easy*. You can get these books on approval and see for yourself how much enjoyment you can have while getting this valuable training and solving interesting practical problems that puzzle your friends and fellow-workers. In no time at all you will be tackling with ease the most difficult question on this subject.

A Complete Reference Work on Mathematics in These Four Inexpensive Books

Starting from the first simple principles, these interesting books take you, by easy stages, into the detailed applications of higher mathematics. Each step is clearly explained and is followed directly by sample problems.

Arithmetic for the Practical Man
Algebra for the Practical Man
Trigonometry for the Practical Man
Calculus for the Practical Man

4 Volumes—1240 Pages—Illustrated

An Expert Gives You These Simplified Methods

Mr. Thompson, the author of these books, is not an ordinary teacher of mathematics. He has had many years' experience in giving students the kind of mathematical training they need in practical work. He presents each practical method and problem in the clearest and simplest way. He gets right down to the kind of information that you need in your daily work. Look up any mathematical problem that puzzles you in these books and see how quickly you get the solution.

Send No Money

Examine These Books for 10 Days FREE!

The coupon below brings you the four books for 10 days' free trial. After 10 days, return the books to us without obligation or send us the small down payment of $1.65—balance in three monthly payments of $2.00 each (5% discount for cash).

MAIL THIS COUPON

D. Van Nostrand and Co., Inc.,
250 Fourth Ave., New York.

Send me MATHEMATICS FOR SELF STUDY in 4 volumes. Within 10 days I will either return the books or send you $1.65 as first payment and $2.00 per month for 3 months —total $7.65. (5% discount for cash.) (Pop. Sc. 2-33)

Name .....

Address .....

City and State .....

Business Connection .....

Reference .....

THE CHANCE OF A LIFETIME!

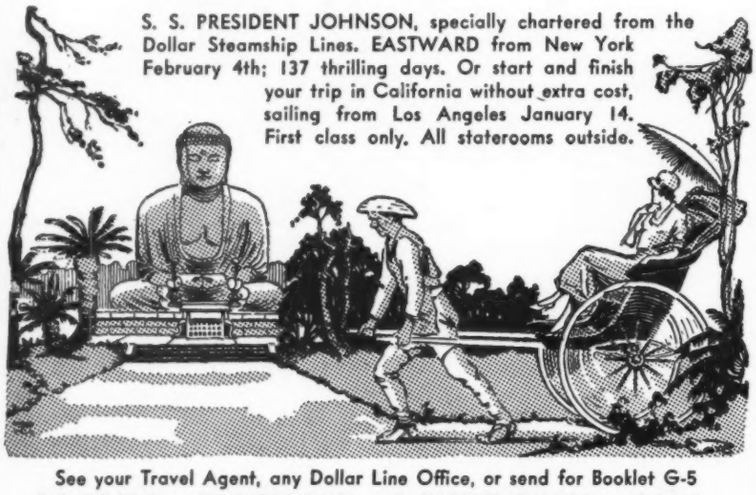
WORLD CRUISE

FOR AS LOW AS $1325 including shore trips, visiting 140 world-renowned cities and places

SHARE in the world's wonders. Burma—Bali—Borneo—Bangkok: All regular 'Round-the-World features and many unusual places that give added distinction.

Steamship rates are going up, but they will not affect this cruise. Perhaps never again, however, can you enjoy such a comprehensive first class cruise at this low cost.

S. S. PRESIDENT JOHNSON, specially chartered from the Dollar Steamship Lines. EASTWARD from New York February 4th; 137 thrilling days. Or start and finish your trip in California without extra cost, sailing from Los Angeles January 14. First class only. All staterooms outside.



See your Travel Agent, any Dollar Line Office, or send for Booklet G-5

JAMES BORING COMPANY, INC.

642 FIFTH AVE., NEW YORK - - - - 333 N. MICHIGAN AVE., CHICAGO

Goodbye
SANDPAPER CHIN

Here Comes the New

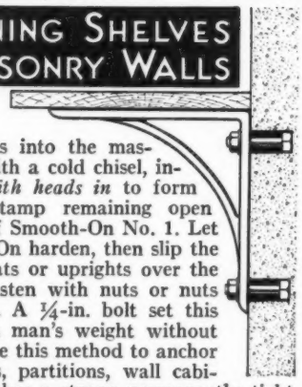
DURHAM
DUPLEX SAFETY RAZOR

EVERYBODY wants an ALL DAY shave—and here it is! Try this NEW razor—and get rid of that "sandpapery" feeling that comes a few hours after shaving. It's all in the *long* blade—the shaving *angle* — and the design! Simple and sure. Nothing to learn — just shave! Note these important features:

1: EXTRA LONG double-edge blade
2: PERFECT BALANCE
3: CORRECT SHAVING ANGLE
4: NO VIBRATION.
5: NEW "HANDY GRIP" HANDLE
6: EASY TO CLEAN

DURHAM-DUPLEX RAZOR CO.
Jersey City, New Jersey
Canadian Office: Toronto, Canada
Copr. Durham-Duplex Razor Co., 1932

FASTENING SHELVES to MASONRY WALLS



CUT holes into the masonry with a cold chisel, insert bolts *with heads in* to form studs, and tamp remaining open spaces full of Smooth-On No. 1. Let the Smooth-On harden, then slip the brackets, cleats or uprights over the studs and fasten with nuts or nuts and washers. A ¼-in. bolt set this way holds a man's weight without loosening. Use this method to anchor cellar shelves, partitions, wall cabinets, etc. Makes a strong permanently tight connection that meets every need.

Use Smooth-On No. 1 also to stop leaks. Seals joints and cracks in pipes, boilers, radiators, etc. Tightens loose handles, locks, hinges, casters, hooks, stems, etc. Makes stripped nuts, bolts and screws hold. Stops leaks in auto radiators, hose connections, cracked water jackets and gear cases, oil and gasoline lines, keeps nuts, lubricator connections, hub caps and wood screws from coming loose, makes dash supports tight and proof against rattle.

Write for FREE BOOK

Get Smooth-On No. 1 in 7-oz., 1-lb. or 5-lb. tin from any hardware store.

Smooth-On Mfg. Co.,
Dept. 58. 570 Communipaw Ave.
Jersey City, N. J.

Do it with **SMOOTH-ON**

WHAT ABOUT ANNUITIES?

(Continued from page 7)

Yet, in three, or five, or ten years they may be perfect "risks." Not wishing to lose the smaller premium accorded to younger age, they take out this type of annuity pending the time when they are again insurable.

DEFERRED SINGLE PREMIUM ANNUITY: There are some men who foresee, through force of circumstances, a need for a definite annual income for life to begin at some future date. It may be because they have some temporary form of income to provide for their immediate needs. Whatever the reason, the means are available through this type of annuity contract. It is bought outright, and the income, guaranteed for life is deferred until the specified date. Because of its terms, this contract brings in an even larger annual income than The Single Premium Annuity, described first in this article.

JOINT SURVIVORSHIP ANNUITY: As the name implies, this contract is written for both man and wife. It is ideal for the couple who are without dependents and who wish to buy for themselves a guaranteed income for as long as they live. In the event of either's death, the *full* sum of the annuity continues to go to the survivor.

TEMPORARY ANNUITY: This is a form of annuity contract designed to be carried in connection with life insurance. Ordinarily it is purchased by a man who already has some form of endowment insurance. That is, a man may have endowment insurance which matures when he is 65. At the age of 45 he may find that circumstances make it necessary for him to have an immediate income. Unwilling to cash in his endowment policy which is designed to take care of his later years, he can purchase a single payment temporary annuity which will tide him over the period of years in which he will need the additional income, or until his endowment insurance matures.

That covers most of the more common forms of annuity contracts. It is not possible, because of space limits, to describe some of these forms more thoroughly. Wherever practical, this department has attempted to analyze insurance coverage from a cost standpoint and to show readers of POPULAR SCIENCE MONTHLY what they pay for when they buy insurance. With annuities, it is impossible to do so without becoming so technically involved that no one, including the writer, will be able to see what "makes the wheels go 'round." This is because annuities, as stated before, are based on special mortality tables which in themselves are highly complicated affairs.

THERE is one more definition to be made, and that is an explanation of the ANNUITY OPTION. This is exercised in lieu of a cash settlement of a life insurance estate. The beneficiary may purchase a guaranteed life income instead of receiving the cash estate. The amount of annual income is determined by the age of the beneficiary *(Continued on page 9)*

CONSTRUCTION KIT FOR MAKING A BATTLESHIP MODEL AT LOW COST

TO ENCOURAGE you to build our new ship model, the battleship *Texas*, which is shown on pages 88 and 89 of this issue, the Popular Science Homecraft Guild is offering a complete construction kit of materials for $6.95, shipped postpaid to any address east of the Mississippi River. To points west of the Mississippi it is necessary to charge 50 cents extra because of the high shipping costs.

The amount of material required to make a model as large and elaborate as this—the hull is 3 ft. long—is surprising. Experienced model makers, most of whom have spent untold hours shopping for hard-to-get supplies, know this, but beginners often have the idea that they can go out and get whatever is necessary in the course of a Saturday afternoon. They quickly discover that the materials used in ship model making are not so easy to obtain, especially in small quantities.

Each kit for making the battleship contains five pieces of soft, straight-grained pine for the hull, ¾ by 6⅜ by 36 in.; all the necessary wood for making the superstructure, turrets, boats, and other parts, each piece being cut to the approximate thickness, width, and length; wooden rods 1/16, ⅛, 3/16, ¼, and 5/16 in. in diameter for masts, guns, searchlights, and the like; sheet brass in three thicknesses; three sizes of brass wire; two sizes of brass rod; 7/8-in. brass tubing for the funnel; brass tubing for the propeller tubes; soft metal and very small chain for the anchors; silk thread; large and small glass beads; nails, pins, and escutcheon pins—in fact, everything required for making an exhibition model except the paints. If a working model is desired, the machinery, of course, must be obtained separately. The kit also includes a complete set of blueprints showing the model full size. Bought separately, they alone cost $1.

If you wish to save yourself the work of marking and sawing out the five main hull pieces or "lifts," these will be cut accurately to shape upon request at an additional charge of 50 cents.

A coupon below is given for your convenience, but if you do not wish to cut the magazine, you may order by writing a separate letter.

Popular Science Homecraft Guild,
381 Fourth Avenue, New York, N. Y.

Please send me all the materials (except paints) required for building a 3-ft. exhibition model of the U. S. S. *Texas*, and also Blueprints Nos. 197 to 200.

☐ I inclose $6.95 (or $7.45 if shipment is to be made west of the Mississippi River).

☐ Send C. O. D.

Name.....
(Print name very clearly)

Address .....

City..... State.....

Note: This offer is made only to readers in the United States.

WHAT ABOUT ANNUITIES?

(Continued from page 8)

at the time of the insured's death. In all cases, it is much larger than the income derived from the usual investments made with the same amount of cash.

To summarize: annuities are primarily designed to produce for the purchaser a guaranteed annual life income or an income over a designated period of years. The word "guaranteed" cannot be emphasized too strongly, especially in these times of sadly deflated security prices. Even in normal times, security prices are subject to fluctuations which make it unwise to place one's *entire* dependence on interest yielding investments. Annuities, bought from reputable companies, are safe —with a capital "S," and as such they deserve an important place in anyone's consideration of financial security and independence.

To Help You Get Ahead

THE booklets listed below will help every family in laying out a financial plan. They will be sent on request.

The Investment Aspect of Life Insurance, by M. A. Linton, presents life insurance as an exceedingly worthwhile investment as well as a form of protection. Provident Mutual Life Insurance Company, of Philadelphia, Pennsylvania, will mail a complimentary copy upon request.

Before 65 and After explains the full details of a Retirement Income, with full Life Insurance, Disability and Double Accident benefits. Sent on request by The Equitable Life Assurance Society, 393 Seventh Avenue, New York City.

How to Get the Things You Want tells how you can use insurance as an active part of your program for getting ahead financially. Phoenix Mutual Life Insurance Company, 328 Elm Street, Hartford, Conn., will send you this booklet on request.

See How Easy It Is tells how it is possible to start off with a definite plan for creating an immediate estate leading to future financial security. Get your copy of this booklet by writing to Postal Life Insurance Company, 511 Fifth Avenue, New York City.

"You Can Have An Income As Long As You Live," a booklet describing simply and clearly how the Annuity can be used to provide a guaranteed income for life. A copy will be sent on request to Inquiry Bureau, John Hancock Mutual Life Insurance Company, 197 Clarendon Street, Boston, Massachusetts.

UNRULY HAIR

Stays Neatly Combed

IS YOUR HAIR difficult to keep in place? Does it lack natural gloss and lustre? It is very easy to give it that rich, glossy and orderly appearance so essential to well-groomed boys.

Just rub a little Glostora through your hair once or twice a week—or after shampooing, and your hair will then stay, each day, just as you comb it.

Glostora softens the hair and makes it pliable. Then, even stubborn hair will stay in place of its own accord.

It gives your hair that natural, rich, well-groomed effect, instead of leaving it stiff and artificial looking as waxy pastes and creams do.

Glostora also keeps the scalp soft, and the hair healthy by restoring the natural oils from which the hair derives its health, life, gloss and lustre.

Try it! See how easy it is to keep your hair combed any style you like, whether parted on the side, in the center, or brushed straight back.

If you want your hair to lie down particularly smooth and tight, after applying Glostora, simply moisten your hair with water before brushing it.

A large bottle of Glostora costs but a trifle at any drug store.

Glostora

Our Readers Say

Nothing Taken for Granted In This Business World

WHILE walking through a business street of this city the other day, I saw a sign on the second story of a building. "Ding-Dong Printing Company," it read, and, beneath, to prevent, I suppose, anybody's supposing that the concern operated a drug store, was the word "Printing." That interested me and I began looking at other signs.

Right next door was the Ajax Electrical Supply Company, which, to avoid mistakes, added "Electrical Supplies" to that legend. The Modern Furniture Company, possibly fearful that a shopper for an automobile might force his way into its show room, had the painter put "Furniture" under its name. The Big City Drug Company—Drugs, read another sign. Proceeding along, I found Stylish Hat Company—Hats; Bosco Arch Support Company—Arch Supports; Neargold Watch Company—Watches; Tip Top Motorcycle Company—Motorcycles. I needn't catalog them all; you undoubtedly get the idea. I've changed the names a little, but have not altered the fact. Isn't there a need for a Society for the Elimination of Useless Use of Paint, or something? Probably the value of the paint, time, and labor required to place totally unnecessary information of this kind on the signs outside of business places, if saved, would be sufficient to pay for the construction of Hoover Dam. I imagine it's just one of those things there's nothing you can do about, but it struck me as so highly ridiculous I had to tell you about it.—W. G. L., Chicago, Ill.

There's Much Astronomy in the Course of a Year

I HAVE been a subscriber to your magazine for some time and have enjoyed the special departments very much. As an amateur in astronomy and meteorology I would like to have you create a department "Helpful Hints to the Amateur Astronomer and Meteorologist." Probably a large number of your readers would join in this request. Hope my suggestion is received favorably by you.—R. F. E., Des Moines, Ia.

How Shape His Iron Pail: Oval, Circular, or Square?

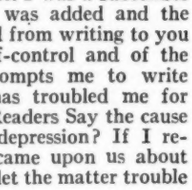
WILL one of your kind readers please help me out of a frightful dilemma? I have a sheet of galvanized iron, forty inches by ten inches, from which I am going to make a pail. Naturally I want it to hold as much as possible. Now the question is, in order to meet that requirement, shall I make the top of my bucket oval, oblong, circular, or square? Or doesn't it make any difference what the shape is? You understand, of course, that I have another piece of iron for the bottom.—P. C., Troy, N. Y.

Homecrafters Organize a Club in Illinois

IT IS with great pleasure that we may now announce to you the organization of "The Homecrafters" club at Rockford, Ill. At our first meeting, where considerable enthusiasm was displayed, we perfected a permanent organization with thirty charter members. The crafts represented are quite varied, covering practically every field of endeavor applicable to "Homecrafters." We expect to have stated meetings every two weeks and have made arrangements for a series of lectures, both oral and illustrated, covering the various crafts. While the club is still a tyro, we cannot recommend too highly the organization of similar clubs elsewhere.—E. R. D., Rockford, Ill.

Can't "Our Readers Say" Keep The Wolf Away?

I HAVE been a reader of POPULAR SCIENCE MONTHLY for a long time. I was a subscriber before this department was added and the fact that I have refrained from writing to you is evidence of great self-control and of the sore perplexity that prompts me to write this. A question that has troubled me for some time is: Was Our Readers Say the cause or result of the world depression? If I remember correctly they came upon us about the same time. I had not let the matter trouble me *much* until I received the current issue and simultaneously read the news that wheat had reached a new all-time low. I have never seen a rational answer to any other question so it would hardly be fair to you—or myself—to expect you to give a rational answer to this one. If you don't feel that you, or any of your readers, can answer it, just pass it up. I guess it won't make much difference. Any one who is light hearted (or headed) enough to see anything funny in your column will not be deeply affected by the depression and if he is keen enough to see a point in any of the answers (or questions, including this one) he can lift himself out of the depression. So please keep right on with Our Readers Say and also with the less important matters of science and invention to which you have always given a large amount of valuable space. —S. P., Fallon, Nev.



When Engines Run on Water Old England Will Have Them

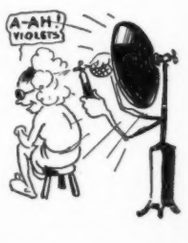
AS A comparatively new reader of POPULAR SCIENCE MONTHLY, may I express my appreciation for the pleasure and interest I have derived from it? The main object of my letter, however, is to answer the suggestion made by V. E. J., Pasadena, Calif., in a recent issue, regarding an engine run on water. Some time ago an officer of the Royal Air Force took out master patents for an internal combustion engine run on water. In his engine, water flowed into a lead plate battery where it was transformed into hydrogen. The gas, then fed into the cylinder in the usual way, was compressed and ignited. Practical tests were claimed to be very satisfactory.—J. B. M., Newcastle-on-Tyne, England.

Then The Mississippi River Must go Rollin' Uphill

DO WE always travel downward? A few years ago a world-renowned astronomer wrote, "In the realm and reaches of space, there is neither up nor down." With that in mind, perhaps several readers of POPULAR SCIENCE MONTHLY may wish to send you their views on the following thought: As there are no spots on the globe that are always called top and bottom, cannot any individual say that the spot where he stands is the top of the world for him? If so, then does not any individual, traveling, always go downward if surface irregularities are disregarded? He would go *down* from London to New York and *down* from New York to London. The confusion arises, I think from our human way of regarding objects and locations practically always as relative to something else. In traveling over our globe, I think there is neither up nor down but, and perhaps properly, outward and around. Yet it would sound odd to speak of going outward to London or around to Paris. I should like the views of others on this question of reality in direction or rather direction only as there may be no such thing as reality in direction.—A. V. L., Philadelphia, Pa.

You Short Wave Workers, Take a Look at This!

THE request of W. S., McAlester, Okla., for an article on the construction of an ultra-violet transformer has my hearty endorsement. I'd like to soak up some ultra-violet myself this winter, and I believe I could manage the price of a bulb, together with the fifty or seventy-five cents worth of material that probably goes into the transformer; but the present state of my finances does not permit the price of a factory-built outfit. I was quite enthused over the short-wave articles recently published, and even thought of trying to qualify for an amateur license—until I acquired a combination receiver. After listening in a couple of times, I concluded there was no room in the air for another amateur. However, I conceived an excellent idea one evening while listening to an amateur dot-dasher



make hash of a good short-wave program. I'll let you in on it before I pass it on to the over-worked Federal Radio Commission. Why not gather all the licensed amateurs into one large city and then surround that city with a thick insulating wall of Heaviside Layer? Then let them pound the key or talk to their hearts' content. If this should find its way into "Our Readers Say," please tell the enraged amateurs to call their shots.— W. G. W., Martins Ferry, Ohio.

Here's a Suggestion for A New Confusion of Tongues

As I have not yet read or heard of auto radios being used in the commercial world, I have decided to write to you, and set forth some of the ways they could be used to advantage. First and most important would be in the taxi business. In our larger cities where two or three companies own hundreds of cabs and have them scattered over the entire city either answering or returning from trips at all times, all calls could be sent to one central office and then broadcast from there, thus eliminating branch offices. The radios could be made so that after a driver received his call and picked up his fare, he could tune his radio from his low wave length to a higher one, and receive a program to his passengers' liking. After completing his run, he would call in and tell the office his location, then tune his radio back to his low wave length and wait for a call that would be near him. In the express business in larger cities, companies having a large fleet of trucks have contracts to handle their freight and deliveries. The system now used is to have the drivers call in at short intervals to see if any new calls have come in near them. If a system similar to the one above were used, a great deal of time would be saved, and fewer trucks would be needed as none would be idle at any time.—B. McM., Denver, Colo.

Image of the Work Done Appears on Spectacles

WILL some worldly-wise man tell me the wheres and wherefores of the following facts, to-wit: A woman came to my office to see if I could clear up her eye glasses. They were of the bi-focal type, the lower lens having been cemented on to the main glass. On the left glass were plainly seen white figures or designs she had embroidered on a pillow sham, working by electric light, and on the other a mulberry leaf design. How did they get there?—J. M. H., Wise, Va.

How Old Is Ann? Take a Look at Her Eyebrows

HERE'S one that will keep the girl friend from putting anything over on you in the matter of age, and I feel that Our Readers Say should have the benefit of this bit of wisdom: The age of a woman can be told by her eyebrows, according to a statement recently made by a British scientist. Eyebrows, he said, change their position as a person grows older. With age, they sink below the upper margin of the eye socket and makeup is ineffective in hiding this evidence of advancing years. Brow lifting comes next, I suppose!—E. T. Providence, R. I.

Bank Robbers Will Please Pose for Their Photos

I HAVE been reading in the POPULAR SCIENCE MONTHLY about how a Doctor Kilmer is able to tell a criminal by his ears. A few weeks ago in a town near Grand Rapids a bank was held up and two or three people wounded. The bandits made a getaway without anyone noticing just what they looked like. I wonder why banks couldn't be equipped with still and movie cameras so in case of a holdup the teller could trip a lever and put the cameras into action and get pictures of the holdup which would give the police something to work with.—G. S., Grand Rapids, Mich.

Nature Will Coddle Our Earth So It Can't Explode

C. E. S., Mason City, Iowa, wants to know, "Why doesn't the earth blow up?" This probably will never happen because the breaking up of the earth's surface would indicate too much outside pressure rather than too much from within. Let us assume that when the crust of the earth was in its gaseous state, being crushed into a solid by two contending forces—heat inside, cold outside—that these two forces were equal, their meeting place being midway between the outer and inner surface of the earth's crust. When the surface became rigid, the outside force became the greater and continued to increase until the surface collapsed causing our mountains and valleys. This shrinkage may never occur again, and it is reasonable to suppose that nature will protect the inner surface of the earth's crust from excessive heat just as it protects the outer surface from excessive cold.—E. L. M., Altoona, Pa.

Here's a Hint to the Army of Hard-working Inventors

ONE badly needed invention is a new, better, pleasanter, and painless substitute for the styptic pencil now used to stop the flow of blood from razor cuts. Something cheap and soothing would fill the bill.—A. V., New York, N. Y.

Followers of Einstein Might Like to Answer This One

THE article in a recent issue of POPULAR SCIENCE MONTHLY regarding the latest results of the Michelson light measurements was extremely interesting. It showed that with the new mile long tube the measured speed of light differed by fifteen miles per second from the former determinations. This is not a great difference in a speed of approximately 186,000 miles per second; and similar differences have been found in all previous experiments. The real interest, however, lies not in this discrepancy with previous measures, but in the light it throws upon the basic experiments of the relativity theory. This theory was entirely based upon the assumption that the Michelson interferometer of 1887 was capable of measuring the relative speeds of two beams of light to within a few inches per second. Michelson made six determinations of this difference on three days, and his apparatus gave differences varying from a few inches to about three feet per second, instead of the theoretical difference of only five feet. Einstein and his followers disregarded these printed statements and asserted that Michelson found no difference. Upon this distortion of facts the whole theory is based. But, if after more than forty years of experiment, it is impossible to determine the actual velocity of light to within fifteen miles per second, is it not absurd to base a revolutionary theory of physics and astronomy upon the failure in 1887 to measure accurately a difference in speeds of two rays of only five feet per second?—C. L. P., Greenport, N. Y.

Naturally, if You Sleep, Your Insomnia Is Licked

How the old ones bob up every now and then with all the fresh frenzy of youth! I have just read that a French physician is telling his patients to sleep with their heads to the north and their feet to the south to avoid insomnia. The magnetic currents thus pass through the body in a direct movement from head to feet, he explains. This was old forty years ago. Probably, it was old 400 years ago. Besides, I don't see what difference it makes what position you're in. If you *sleep* you surely won't be troubled with insomnia, what?—A. H., Forest Hills, L. I., N. Y.

Earth's Magnetic Field May Make Light Hesitate

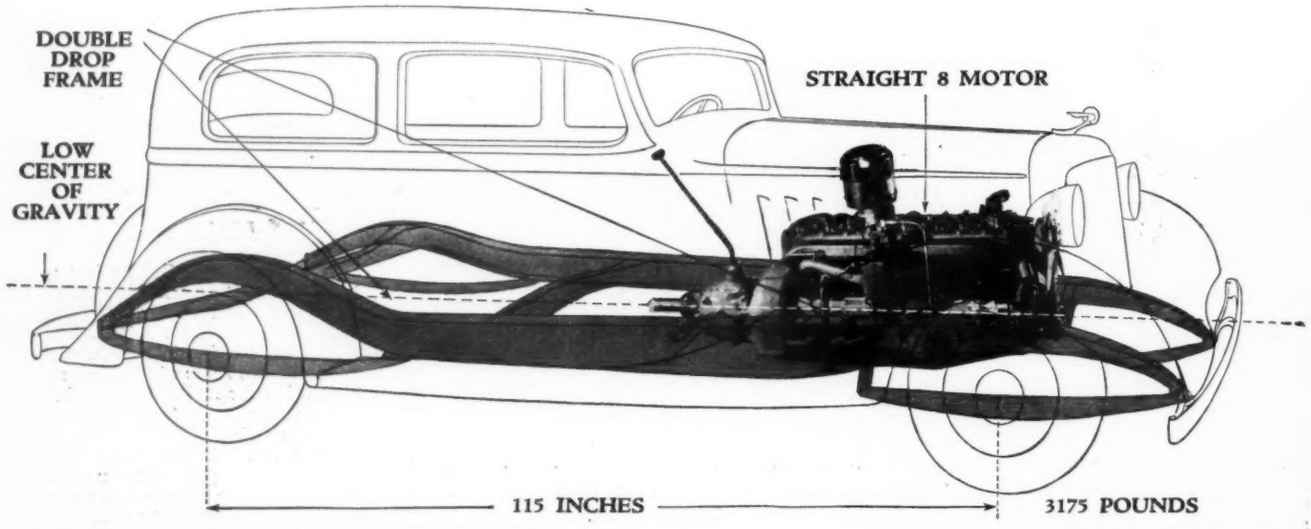
AN ARTICLE by John L. Coontz, in a recent issue of POPULAR SCIENCE MONTHLY, described the tube used by Dr. Michelson in testing the speed of light. A friend and I have indulged in considerable speculation regarding the *possible cause* of the error recently discovered in the speed of light, and finally decided to write you for the purpose of obtaining certain information. In what direction was the test tube when the test was made from mountain peak to mountain peak, from east to west or from north to south? When the tube was set up to make the test did they set it up so that the test took place in the same direction as the previous test? Is it possible that the earth's magnetic field has a retarding influence on the speed of light when the travel of the light ray is at right angles to the earth's magnetic field? There is the further possibility of error because of the fact that both of these tests have been made along, or near, the surface of the earth. It is not possible that the speed of light is reduced a trifling amount when it is in the presence of an influence such as a body the size of the earth with its attendent atmosphere, magnetic field, etc.? One point on which my friend and I differ is regarding the action of a magnetic field in a vacuum. Do magnetic lines of force *deflect* from their course to avoid a vacuum or do they continue uninterrupted on their course?—L. S., Butler, N. J.

Many a Man Is Thankful He Hasn't Four Legs

THE dumbest four-legged creature on earth is the frog, according to Harry F. Harlow, psychology professor, at the University of Wisconsin, who recorded the time required for a frog to react to various stimuli. These records showed it reacts more slowly than any other laboratory animal and that it learns nothing from experience. Wasn't it nice of Professor Harlow to confine his statement to "four-legged creatures?" Where'd we get off if he hadn't? And what relation does that make us to frogs?—J. M. M., Pittsburgh, Pa.

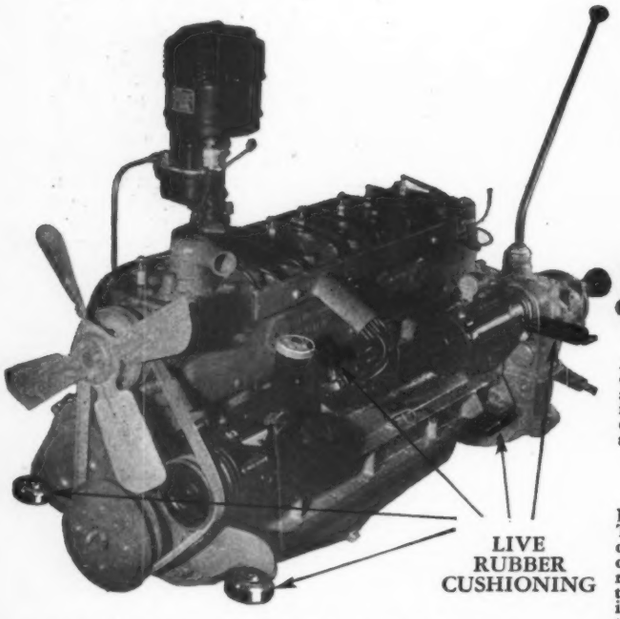
FACTS *you'll want to know about* *General Motors' new* PONTIAC *Straight* 8

Everybody interested in things mechanical will want to know about the many new and practical ideas General Motors engineers have developed in building the new Pontiac Straight 8. Here are some of the outstanding features—look for more in next month's issue. Pontiac is a *big* Straight 8. The power plant is a new, smooth, 77-horsepower engine, L-head type. Full pressure lubrication. Perfect balance of engine gives greater smoothness. Capable of 75 to 80 miles an hour. And the new, big Pontiac is priced right down in the low-price field. Mechanics and shop men are particularly invited to inspect the new Pontiac.

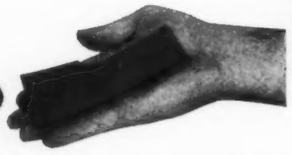


There are 3175 pounds of weight in Pontiac's 115-inch wheelbase two-door sedan. The double-drop frame, with 6 cross-members, is specially built to give the chassis great strength and rigidity. Rubber cushioning at 37 chassis points affords unusual riding ease and quietness.

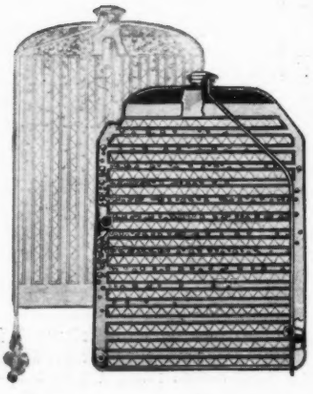
Fisher No-Draft Individually Controlled Ventilation on closed models is the biggest improvement in riding pleasure in years. Side windows can be separately regulated to give just the ventilation desired. Stops drafts—prevents colds. Prevents the dangerous annoyance of steamed or frosted windows.



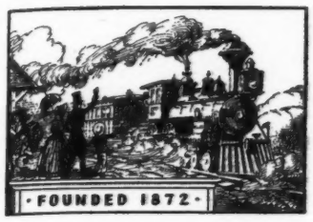
Pontiac's Straight Eight engine is mounted on 5 steel-reinforced rubber supports, eliminating all metal-to-metal contact between engine and chassis. This construction ends vibration and torque reaction throughout the entire driving range, yet keeps engine sensibly anchored to frame. Notice three types of mounting used.



At 37 points in Pontiac's chassis there are cushionings of live, compressed rubber, such as illustrated above. This cushioning system prevents squeaks and rattles, eliminates vibration, softens road jolts and jars, thus adding to riding comfort.



Pontiac uses the cross-flow radiator. This type of radiator minimizes the loss of water or anti-freeze liquid by boiling or vaporization. The two tanks are separated, and steam or vapor cannot reach the over-flow pipe without first circulating through the tubing and then through the liquid. Makes it possible to keep the engine thoroughly cooled with less water—only enough is required to cover outlet cock. Capacity, 15 quarts. All copper core, honeycomb type. Reduces rust and corrosion.



POPULAR SCIENCE
MONTHLY

February 1933 Vol. 122, No. 2

RAYMOND J. BROWN, *Editor*

FIRST Transatlantic Air Line

LINKS TWO CONTINENTS

Great seaplanes of this type, will be used when the first regular flying service over the Atlantic is inaugurated. Note loop aerial on nose of craft for the radio compass that guides flyers

SLIDING down the map 1,800 miles from the bulging west coast of upper Africa to the projecting northeastern tip of South America, a few weeks hence, a flying boat will inaugurate the world's first regularly-scheduled transatlantic airline.

This aerial bridge across the South Atlantic will link Bathurst, just west of the Sahara, in British Gambia, with Pernambuco, south of the Amazon, in Brazil. It will clip nine days from the traveling time between Berlin, Germany, and Rio de Janeiro, Brazil.

At first, the big machines, on a biweekly schedule, will carry only mail and express. Later, passengers will be accommodated as well. Following the trail blazed by daring ocean flyers, the pilots will take off surrounded by elaborate precautions and aided by the last word in navigation instruments. For behind the project lies more than three years of intensive preparation by the Lufthansa, the great air transportation organization of Germany.

By *Rene Leonhardt*

While German ships will be the first to shuttle back and forth in an air service over the South Atlantic, the planes of other nations will be close behind. Both France and Italy have entered the lists and at this writing are putting finishing

2 POWERFUL CRANE HOISTS FLYING BOAT TO DECK AND PLACES IT ON WORLD'S LARGEST AERIAL CATAPULT
1 FLYING BOAT LANDS WITH MOTORS RUNNING IN WAKE OF 'WESTFALEN' AND SLIDES ON TO CANVAS DRAG SAIL
3 FLYING BOAT IS THEN REFUELED AND SHOT INTO THE AIR AT TAKEOFF SPEED FOR THE SECOND LEG OF ITS OCEAN HOP

REFUELING A SEAPLANE AT MOTHER SHIP 900 MILES FROM LAND

Drawing shows how the transatlantic flyers will be able to land in mid-ocean, refuel and take off again on second leg of the journey

touches on plans for similar links across the sea to South America.

Four large flying boats are nearing completion in French factories for use in a transatlantic airline which will connect Paris with Buenos Aires, 8,200 miles away in the Argentine. On this route, the hop-off for the ocean crossing will be made from the African coast at Dakar, on Cape Verde, a hundred miles north of Bathurst.

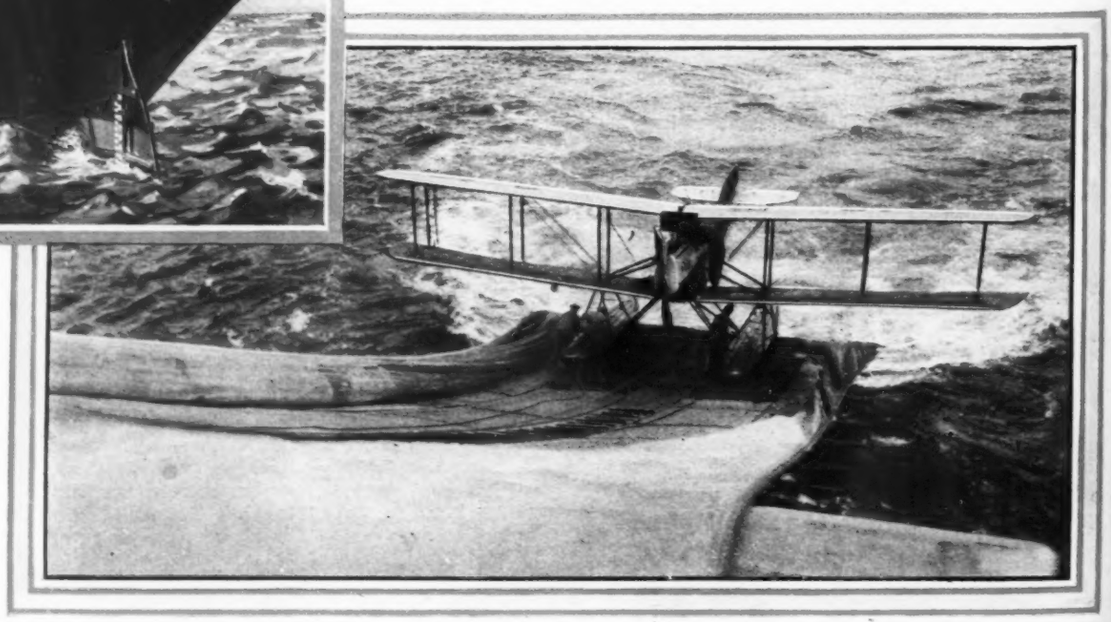
For the last two years, Italian experts have been busy compiling weather data and other information vital to a trans-oceanic airline. They have even worked out time-tables and elaborate cost figures. Latest advices from Rome indicate that the construction of the Italian planes will be pushed forward at top speed.

While the race is thus on over the South Atlantic, the powerful Pan-American Airways, in the United States, announces it is building six giant flying boats, larger than anything hitherto flown on commercial airlines, for use over the North Atlantic between America and Europe. These fifty-passenger planes, designed to fly 2,500 miles with full load, will probably go by way of Greenland and Iceland. They may also pioneer on an airway to the Orient, crossing the Pacific with one stop at the Hawaiian Islands. The keels of these superplanes have already been laid and work on them is progressing at the Sikorsky plant, Bridgeport, Conn., and at the Glenn L. Martin factory, Baltimore, Md.

In 1927, when Charles A. Lindbergh made his historic thirty-three-hour dash to Paris, the possibility of transatlantic airlines was discussed on all sides. Predictions were made that they would be in operation at dates that ranged from a decade to a century hence. The average between the time set by the most optimistic and the most conservative prophets indicated that a generation would pass before they became a reality. Yet children born in 1927 will hardly be in first grade when the German boat climbs into the air on its first scheduled transatlantic run to South America in March or April of this year!

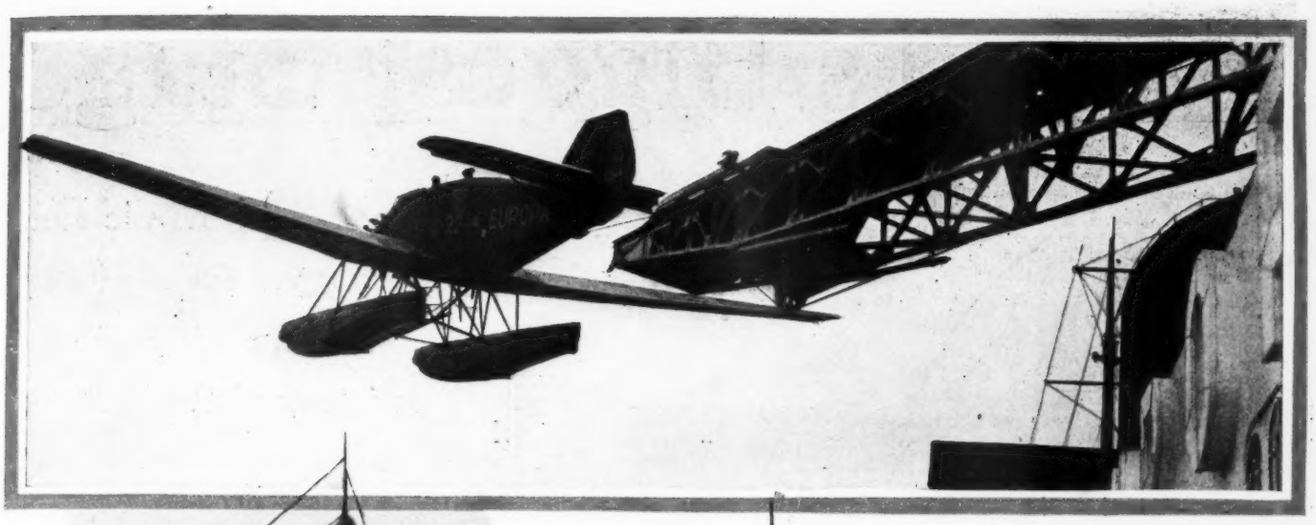
The most unusual feature of the German plan is the *Westfalen,* a 6,000-ton North German Lloyd liner, which will cruise about in circles 900 miles from shore and act as a refueling station and repair depot for the aerial fleet in mid-ocean. The 409-foot vessel will carry tools, spare parts, fuel and oil. Expert mechanics will stand ready to repair or tune up an incoming plane at a moment's notice. From a powerful broadcasting station on board, signals will flash to the airliners speeding toward the circling ship, giving its position and hourly weather reports. In storms or heavy weather, the *Westfalen* will form a midocean harbor of refuge for the planes.

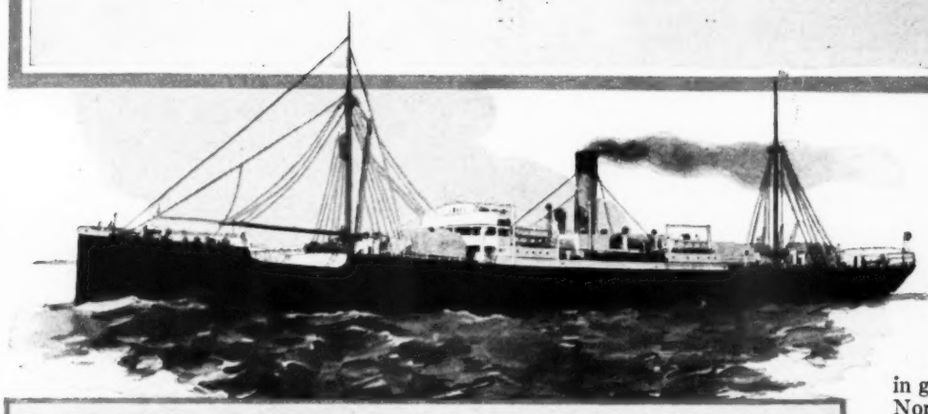
Under such conditions, one part of the unique vessel's equipment will be of special value. This is an immense drag sail of heavy canvas, similar to the one carried by the Swedish cruiser *Gotland,* which served as the basis of the cover design of last month's issue of POPULAR SCIENCE MONTHLY. Fifty feet wide and more than half a block long, it will trail over the water from the stern of the vessel, allowing the ship to pick up seaplanes from the water while traveling at full speed. Crosswise pontoons near the end have a braking effect, keeping the canvas taut. The flying boats, with engines running, land in the wake of the steamer, slide up on the trailing edge of the canvas, and then are hauled up the incline to the deck by a powerful crane of special design. In



LANDING FIELD TRAILED BY BIG SHIP

Cruising in the middle of the ocean, the German ship will be equipped with a canvas landing field like the one upon which a plane is seen alighting at the right. Above, the canvas field is rolled up when not needed by a plane





WORLD'S BIGGEST CATAPULT

By means of a giant catapult, similar to the one shown above, the planes will be hurled into the air from the deck of the big liner. At left, the *Westfalen* which will service the ocean flying planes and shelter them during a storm

The radio room of the transatlantic planes is located directly behind the pilot and the operator is in constant communication with the far-distant mother ship

stormy weather the dragging canvas will create a strip of relatively smooth water behind it, thus aiding the pilot in landing his heavy ship.

A few days ago German liners, steaming out into the North Sea from Hamburg and Bremen, passed the *Westfalen* off the island of Helgoland. It was dragging its long white train behind it, carrying out painstaking experiments to determine the best speeds for different water conditions. Time and again, during this three-day test, a big Dornier-Wal flying boat swooped down, skimmed over the water and slid up on the canvas while the *Westfalen* was being driven ahead at full speed by her 2,700-horsepower engines.

Immediately afterwards, the big ship docked at Bremen. Here, workmen began installing the world's biggest aerial catapult on her deck. Driven by giant blasts of compressed air from a battery of heavy steel cylinders, this 150-foot gun will have sufficient power to shoot a loaded fifteen-ton flying boat into the air at takeoff speed. After the machines of the ocean service have been pulled up the canvas drag sail and refueled, they will be shot off the deck from the catapult to begin the second leg of their over-water journey to Pernambuco.

The present catapult launching record is held by England. In the summer of 1931, at the Farnborough flying field of the Royal Air Force, near London, a land catapult, with a 4,000-horsepower compressed air engine, hurled a nine-ton bombing plane into the air with a run of ninety feet. The *Westfalen* catapult, mightiest of all, will be similar in general design to those now used on the North German Lloyd liners, *Europa* and *Bremen*, to launch mailplanes as the vessels draw near to the coasts of either North America or of Europe.

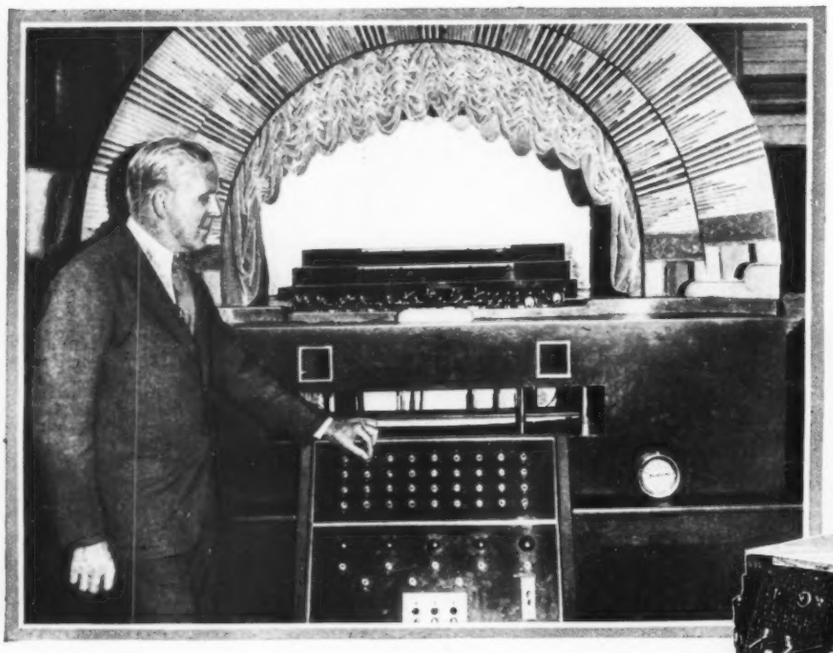
Because of his wide experience with these catapults, Heinz Blankenburg, a veteran ship-to-shore pilot, has been selected to handle the controls on the initial transatlantic flight of the new airline. The 6,000-mile route, over which planes will fly on their three-day race from Berlin to Rio de Janeiro, will carry them above mountains, deserts and jungles, as well as over the South Atlantic.

Imagine that journey. The start from Berlin is a little before noon. Tempelhof Airport, the busy hub of European skyways, is at the height of its activity. Air liners are coming and going. The roar of big motors fills the air. At the starter's signal, the land plane, which will cover the first legs of the long journey, speeds down the runway, climbs slowly into the air, and heads south over a patchwork carpet of farms spread out half a mile below. Potsdam, Leipzig, Nuremberg pass by. Ahead, is the blue water of Lake Constance with the white backbone of the Swiss Alps rising above it. A few minutes later, the plane spirals down to a landing at Friedrichshafen, 400 miles south of the point at which it took off.

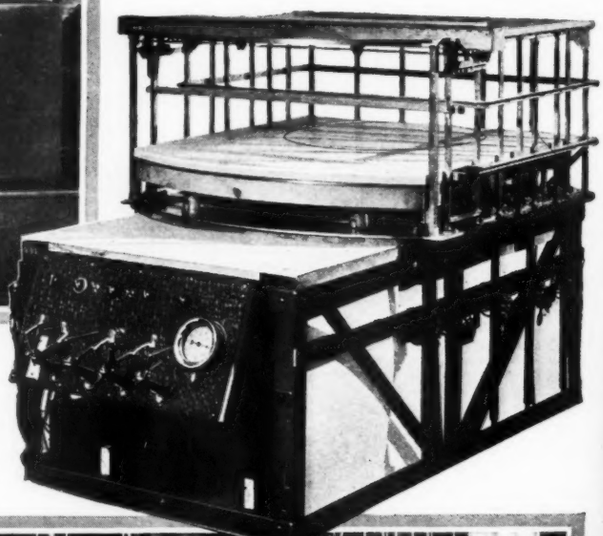
Fuel is pumped into the tanks, mail is stored away on board, and the ship is off again, out over the lake and the huge Zeppelin sheds on its shore. In wide circles it climbs to nearly 15,000 feet before it heads south, clearing the snow-covered barrier of mountains and sliding down over southern France to the second landing at Marseilles, 800 miles from Berlin. Here, it refuels and takes off by floodlight, climbing over the Pyrenees and heading diagonally across Spain. The landscape below spreads out in moonlight. Finally, the ship comes down in the bluish glare of the *(Continued on page 104)*

World's Biggest Stage

Radio City Music Hall Equipped for the Most Elaborate Effects in the History of the Theater



Peter Clark, New York architect, and designer of the remarkable stage for Radio City Music Hall, is showing the model used in building the stage



AS THIS issue goes to press, the world's largest indoor stage, a wonderland of ingenious mechanisms at the Radio City Music Hall, Rockefeller Center, New York City, is ready for its first performance. Elaborate mechanical features, shown here by our artist, will make possible the presentation of super-spectacles, ballets, band concerts, choruses, variety acts, circus performances, minstrels, with scenic effects never before attained.

The stage, 144 feet wide and eighty feet deep, can be raised or lowered hydraulically in three sections, presenting different levels. In addition, a circular center section, fifty-five feet in diameter, can be revolved in either direction. When each position of the stage is assumed, the sections automatically lock in place. This is said to be the first time a revolving stage and a stage that can be raised and lowered have been combined. The design was worked out by the New York firm of theatrical architects, Peter Clark, Inc.

Twin pipe-organ consoles mounted on wheels roll into view, one on either side of the stage, when in use, and slip back into special alcoves when the organs are silent. Another feature is a motorized orchestra pit, seventy-five feet long and holding more than a hundred players, which rises into view at any one of three different positions on the stage.

Experts, standing before long rows of electric buttons in a small pit in front of the stage, control the movements of the various sections, the appearance and disappearance of the organ consoles and the rise and descent of the orchestra pit. In addition, they adjust the position of a mammoth contour curtain at the front of the stage. Thirteen lift cables, each with a separate electric motor, permit it to be draped into any one of a score of different positions to attain unusual scenic effects.

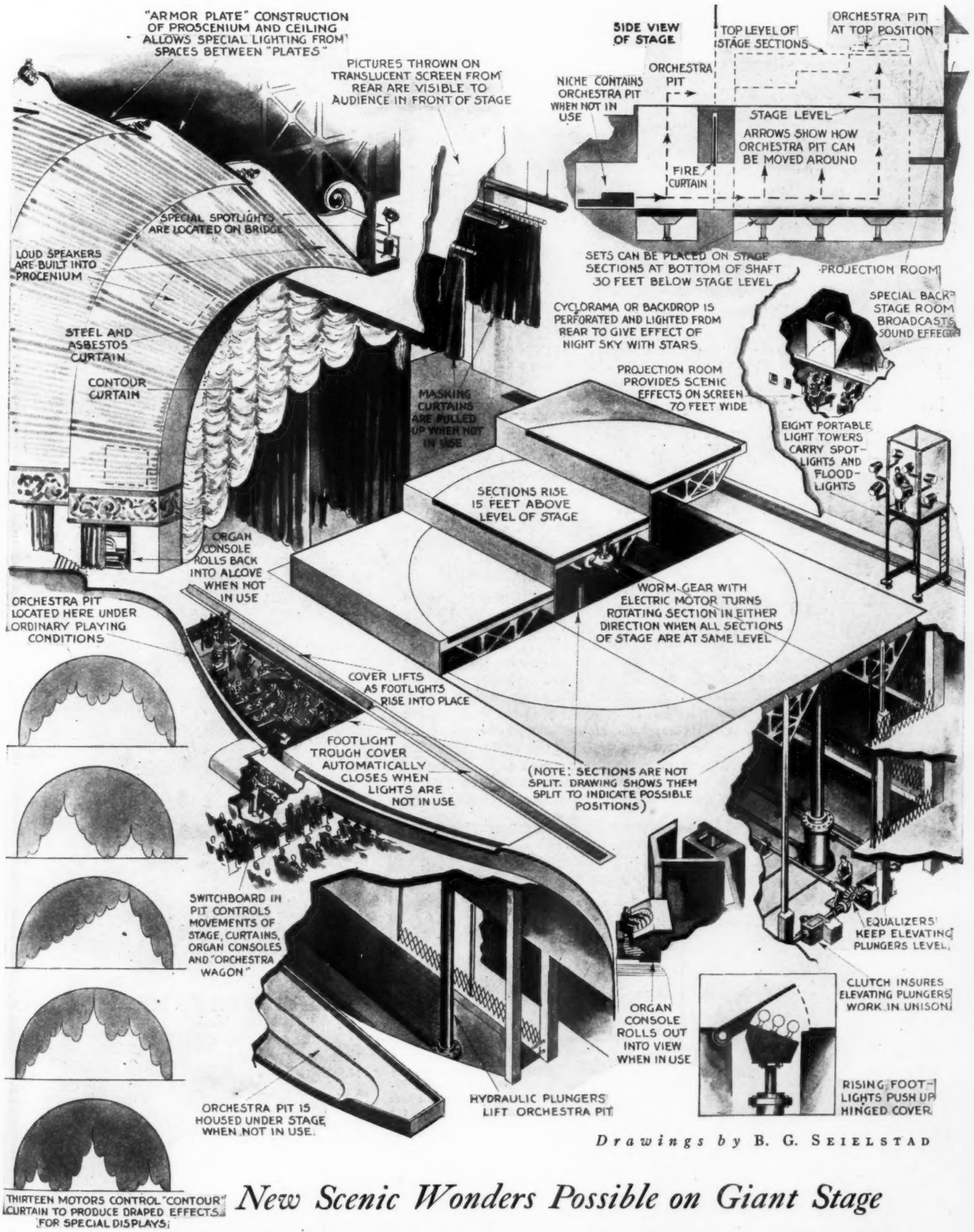
The unique armor-plate construction of the ceiling of the hall permits special spotlights to be played upon the stage from openings between the various overlapping sections. Runways and compartments for the operators of these lights have been incorporated in the design of the roof of the building.

On either side of the stage, steel light towers, thirty feet high, hold from seven to twenty-five spot and floodlights, fed by electric cables dropping from the ceiling. These towers are mounted on wheels so they can be moved about to provide spectacular lighting displays. Behind the stage a special room broadcasts sound effects while a projection booth adds to the realism of performances by scenic effects flashed upon a screen.

STAGE MODEL LOOKS LIKE REAL THING

A working model of the Music Hall stage, at top, in which many of its mechanical features can be seen. Above, a view of the stage as seen in a photograph of the model. Note the contour curtain at left

Is Marvel of Mechanics


"ARMOR PLATE" CONSTRUCTION OF PROSCENIUM AND CEILING ALLOWS SPECIAL LIGHTING FROM SPACES BETWEEN "PLATES"
PICTURES THROWN ON TRANSLUCENT SCREEN FROM REAR ARE VISIBLE TO AUDIENCE IN FRONT OF STAGE
SIDE VIEW OF STAGE
TOP LEVEL OF STAGE SECTIONS
ORCHESTRA PIT AT TOP POSITION
ORCHESTRA PIT
NICHE CONTAINS ORCHESTRA PIT WHEN NOT IN USE
STAGE LEVEL
ARROWS SHOW HOW ORCHESTRA PIT CAN BE MOVED AROUND
FIRE CURTAIN
SPECIAL SPOTLIGHTS ARE LOCATED ON BRIDGE
LOUD SPEAKERS ARE BUILT INTO PROCENIUM
SETS CAN BE PLACED ON STAGE SECTIONS AT BOTTOM OF SHAFT 30 FEET BELOW STAGE LEVEL
PROJECTION ROOM
SPECIAL BACK STAGE ROOM BROADCASTS SOUND EFFECTS
CYCLORAMA OR BACKDROP IS PERFORATED AND LIGHTED FROM REAR TO GIVE EFFECT OF NIGHT SKY WITH STARS
STEEL AND ASBESTOS CURTAIN
CONTOUR CURTAIN
PROJECTION ROOM PROVIDES SCENIC EFFECTS ON SCREEN 70 FEET WIDE
MASKING CURTAINS ARE PULLED UP WHEN NOT IN USE
EIGHT PORTABLE LIGHT TOWERS CARRY SPOT-LIGHTS AND FLOOD-LIGHTS
SECTIONS RISE 15 FEET ABOVE LEVEL OF STAGE
ORGAN CONSOLE ROLLS BACK INTO ALCOVE WHEN NOT IN USE
ORCHESTRA PIT LOCATED HERE UNDER ORDINARY PLAYING CONDITIONS
WORM-GEAR WITH ELECTRIC MOTOR TURNS ROTATING SECTION IN EITHER DIRECTION WHEN ALL SECTIONS OF STAGE ARE AT SAME LEVEL
COVER LIFTS AS FOOTLIGHTS RISE INTO PLACE
FOOTLIGHT TROUGH COVER AUTOMATICALLY CLOSES WHEN LIGHTS ARE NOT IN USE
(NOTE: SECTIONS ARE NOT SPLIT. DRAWING SHOWS THEM SPLIT TO INDICATE POSSIBLE POSITIONS)
SWITCHBOARD IN PIT CONTROLS MOVEMENTS OF STAGE, CURTAINS, ORGAN CONSOLES AND "ORCHESTRA WAGON"
EQUALIZERS KEEP ELEVATING PLUNGERS LEVEL
CLUTCH INSURES ELEVATING PLUNGERS WORK IN UNISON
ORGAN CONSOLE ROLLS OUT INTO VIEW WHEN IN USE
RISING FOOT-LIGHTS PUSH UP HINGED COVER
HYDRAULIC PLUNGERS LIFT ORCHESTRA PIT
ORCHESTRA PIT IS HOUSED UNDER STAGE WHEN NOT IN USE.
THIRTEEN MOTORS CONTROL "CONTOUR" CURTAIN TO PRODUCE DRAPED EFFECTS FOR SPECIAL DISPLAYS

Drawings by B. G. SEIELSTAD

New Scenic Wonders Possible on Giant Stage

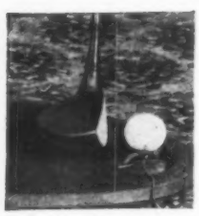
Diagram of the world's biggest stage, showing in detail the sectional nature of the stage which can be raised to three different levels and also revolved in either direction. Note orchestra pit which can be dropped from view

When this frame, with its supporting pontoons, is laid flat in the water, it will sustain a swimmer's weight, as seen at top, and progress is made by kicking paddles and working oars

FRAME TEACHES SWIMMING

NOVICES at swimming may acquire confidence with the aid of an odd mechanical device, just introduced in Germany. The swimmer lies on a floating frame supported at an adjustable height in the water by pontoons, and propels it forward by placing his feet in a pair of stirrups and kicking. Thus he learns the proper motions of the legs. Oar-like paddles may also be operated with the arms. The hinged propelling fins open automatically when pushed backward against the water.

NEW INDOOR GOLF TEE



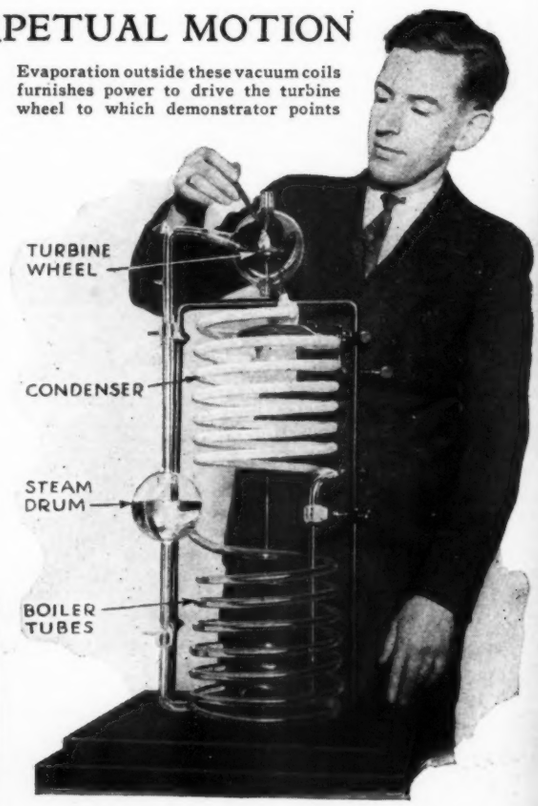
INDOOR golf practice without damage to the floor is possible with a new rubber mat. A rubber tee is attached and a soft ball is tethered on an elastic cord.

RADIOPHONE FOR PLANES WEIGHS ELEVEN POUNDS

AN UNUSUALLY compact radiophone transmitter weighing eleven pounds, has been developed for small planes by engineers of the Bell Telephone Laboratories. With this a pilot may call an airport and ask the condition of the field, direction and velocity of the wind, and what obstructions interfere with landing. The transmitter has a range of thirty to forty miles.

LOOKS LIKE PERPETUAL MOTION

A TURBINE wheel spins continuously, despite the absence of any visible source of power, in a glass model called by its New York builder "the nearest thing to perpetual motion." Its closed circuit of glass tubing is exhausted to so high a vacuum that water, in the bottom, boils at room temperature. Rising steam drives the tiny turbine and then condenses in upper tubes, which are kept twenty degrees cooler than the room by a moist wick wrapped around them. This cooling effect by evaporation is the real motive force. As long as the tip of the wick is kept in water, the device develops about 1/60,000th of a horsepower, enough to demonstrate a new source of energy.



Evaporation outside these vacuum coils furnishes power to drive the turbine wheel to which demonstrator points

Radiophone transmitter with top and sides removed to show compact arrangement of parts

Designed for use in light planes, the radiophone, left, is seen complete and ready for operation. It has a range of 30 to 40 miles and weighs only 11 pounds

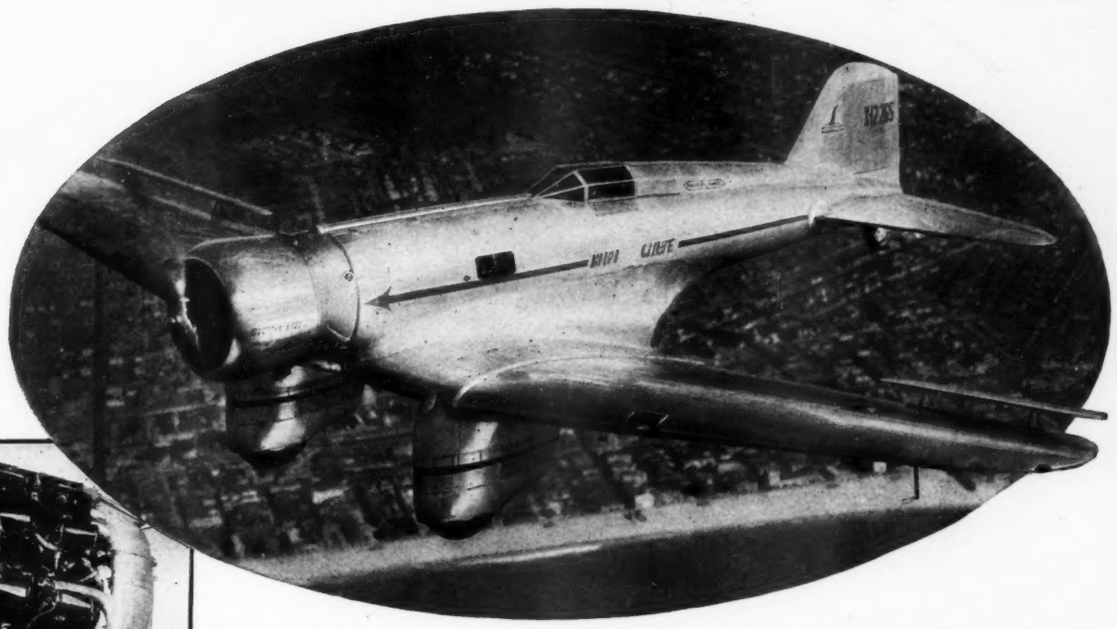
CIGARETTE CASE FOR AUTO

A CIGARETTE case that clamps to the steering wheel of a car makes it unnecessary for a driver to fumble through his pockets for a smoke. It is installed in a few seconds with the aid of an adjustable metal clamp. The case has a pocket for license papers.

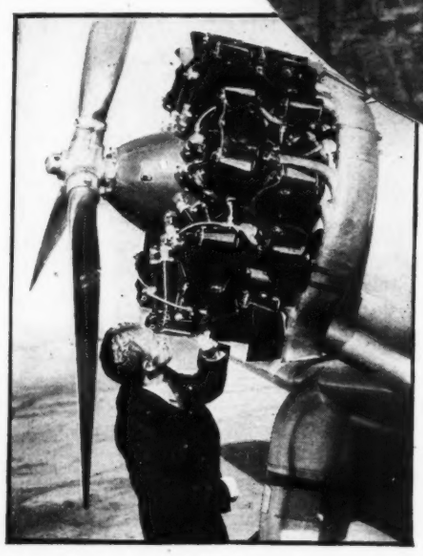
This case clamps to steering wheel

Fourteen-Cylinder Motor in Hawks' New Plane

Striking picture at right shows the new all-metal speed plane just completed in a California shop for Captain Frank Hawks. It has a top speed of 250 miles an hour and is fitted with instruments for blind flying

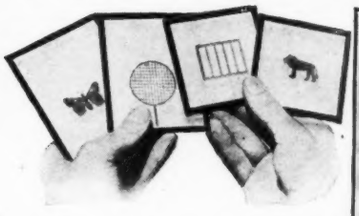


Fourteen cylinders in Hawks' plane are arranged in two circles as is seen in the photo below. The motor will develop over 700 horsepower

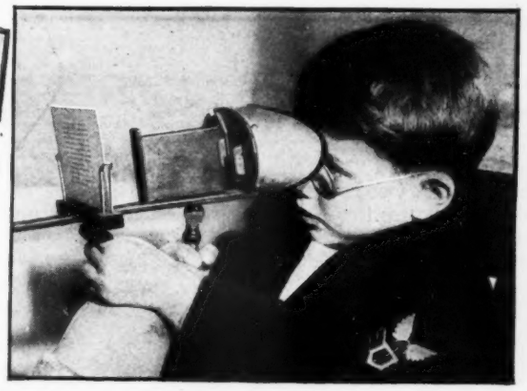


ENGINEERS tried to see how many cylinders they could crowd on a motor for Captain Frank Hawks' newest speed plane. The result was a 700-horsepower engine with fourteen cylinders arranged in two adjoining circles, one behind the other. The unusual power plant is expected to propel the bullet-like craft of metal at a top speed of 250 miles an hour and enable it to set new transcontinental records.

CROSS-EYES NOW CURED BY PICTURES



Attractive picture cards, above, are used in the new method of curing cross-eyed children without an operation



With the stereoscope-like instrument, right, the cross-eyed patient tries to make two pictures fuse together

CURING cross-eyes is play for youthful patients at a New York eye clinic, opened recently. A child places a pair of attractive picture slides in an instrument resembling an old-fashioned stereoscope and manipulates the device to make the pictures fuse together. Thus he tries to trap a lion in a cage or catch a butterfly in a net. Through corrective exercises of this sort, a cure is often effected without recourse to a surgical operation, which hitherto was nearly always considered necessary.

ILLUSTRATED LECTURES GIVEN BY MACHINE

CANNED lectures may now be had in two dozen large cities, and soon will be available in many more, simply by calling a telegraph messenger. He brings with him a new type of talkie machine that delivers a talk on the desired subject from a wax record. Its projector meanwhile throws still pictures one by one upon a screen. A warning bell notifies the messenger, who operates the machine, when to advance the film to the next picture.

Telegraph messenger, left, is operating a canned lecture machine that talks and throws a picture on the screen as shown above

REEL PART OF FISHPOLE

WITH its reel built into the handle, a new casting rod offers advantages to fishermen. Since the reel is an integral part of the outfit, it cannot be lost nor come loose at a critical moment. Reel and handle are made of aluminum alloy and the grip is formed of cork.

AMATEUR THEATRICAL SCENERY COMES IN COMPACT KIT

ANYONE may build his own scenery for amateur theatricals, with the aid of a new kit designed for use with a stage depth of about twenty feet and a proscenium opening of thirty-five feet. It includes complete scenery hardware, sizing, and glue, with full plans for three different arrangements of scenery, and suggestions for painting the set. Openings for doors and windows are provided, as well as materials for a fireplace, leaving only scenery linen and frame lumber to be purchased.

Everything necessary to the building of scenery for amateur theatricals, except the linen and frame lumber, is contained in this kit which is designed to provide scenery for a stage twenty by thirty-five feet in size

ALL METAL DISHES BARRED BY ANTARCTIC EXPLORER

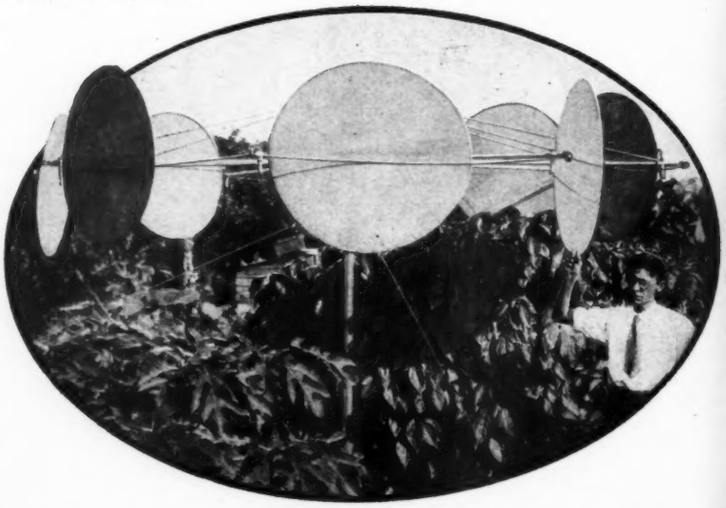
WHEN polar explorers sit down to dine, tableware made of wood is considered good taste. Metal cutlery, unprotected from the frost of sub-zero temperatures, would stick to their lips and "burn" the skin away. The photograph below shows wooden forks, spoons, bowls, belaying pins and dog harness toggles just completed for Rear-Admiral Richard E. Byrd's second Antarctic expedition by a Newberg, Ore., woodworking concern. The maker is not permitted to use the least bit of metal in making these implements, of which a complete supply has just been delivered.

FLAGPOLE, IN TRUCK, CROSSES WORLD'S BUSIEST STREET

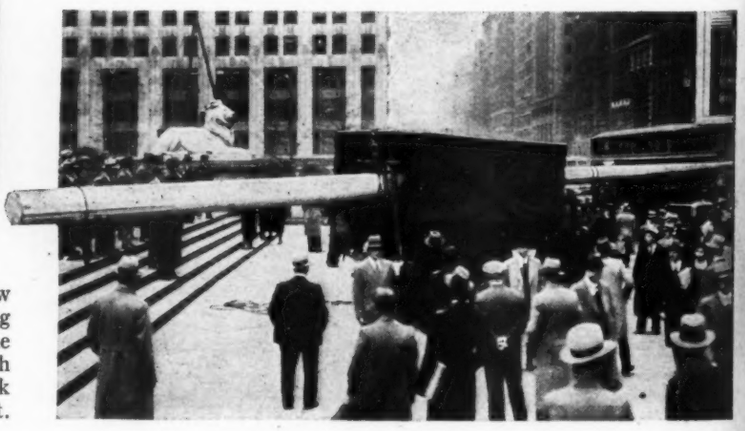
CARRYING a flagpole, nearly 100 feet long, from the New York Public Library to the repair shop recently gave moving men a problem. The pole was loaded at what is probably the world's busiest traffic crossing, Forty-second Street and Fifth Avenue. The movers cut a hole through the body of a truck and pushed the pole aboard as shown in the photo at right.

DISK WINDMILL IS HURRICANE PROOF

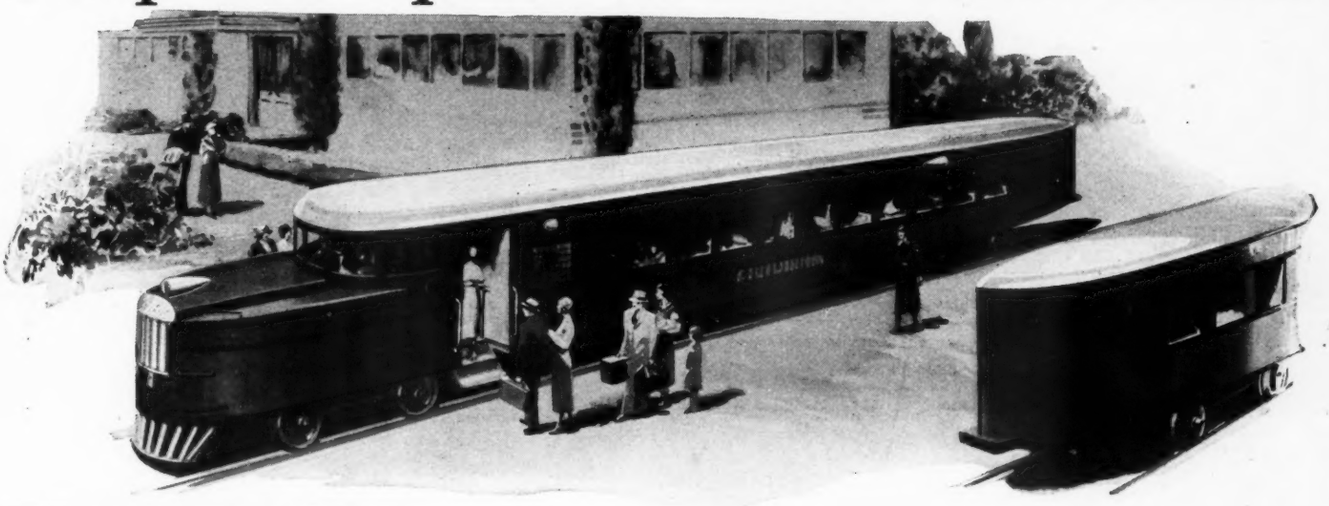
PROOF against hurricanes is a midget windmill devised by a Miami, Florida, inventor. The queer-looking disks that serve as vanes automatically drop off if struck by a gale, leaving the frame undamaged. If broken, the disks may be replaced at a cost of only five cents apiece, according to the inventor. Several of his neighbors, living in a region subject to violent storms from the sea, are using windmills of this novel type to pump water.

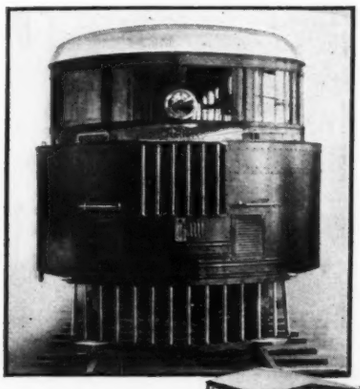


Disk vanes, driving this windmill, drop off, with little damage, if hit by a gale



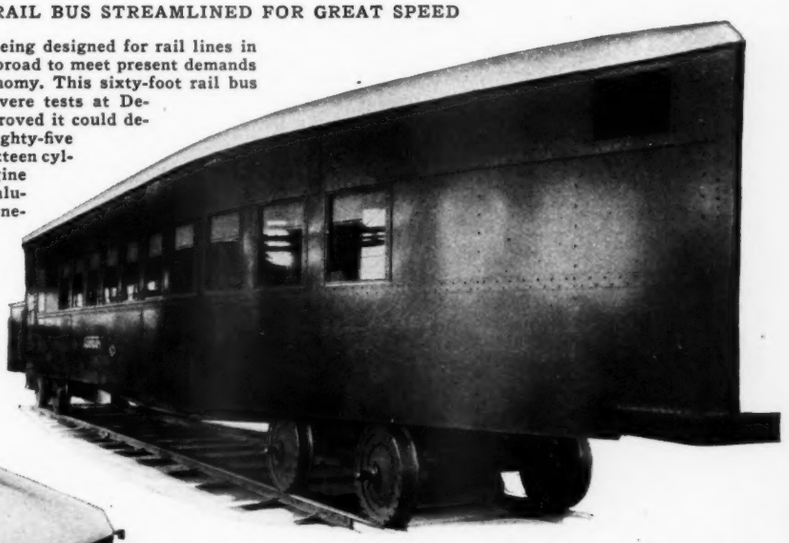
Airplane Speed in New Rail Buses





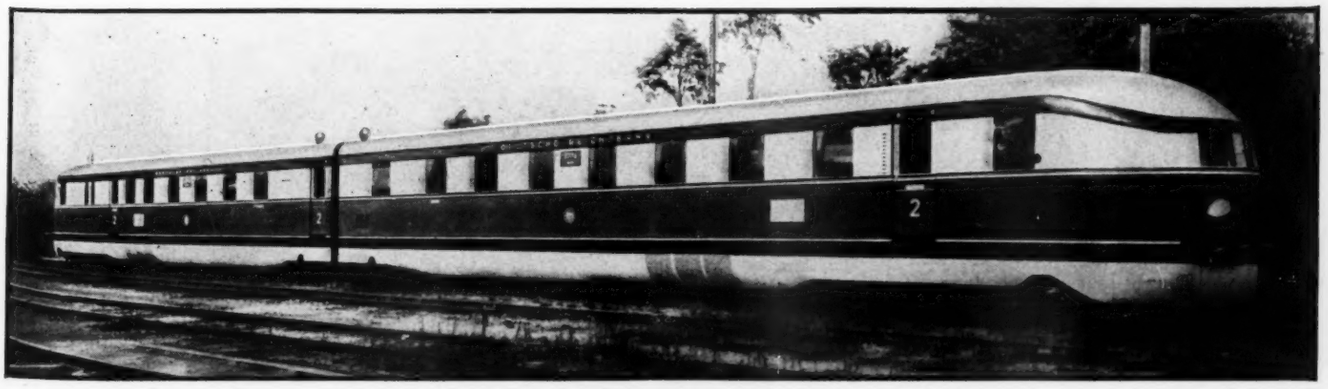
RAIL BUS STREAMLINED FOR GREAT SPEED

Strange cars are being designed for rail lines in this country and abroad to meet present demands for speed and economy. This sixty-foot rail bus has been given severe tests at Detroit, Mich., and proved it could develop a speed of eighty-five miles an hour. A sixteen cylinder gasoline engine drives it. Made of aluminum, it is only one-quarter as heavy as a railway car. At left, view shows rounded front and, right, the wedge-shaped rear end



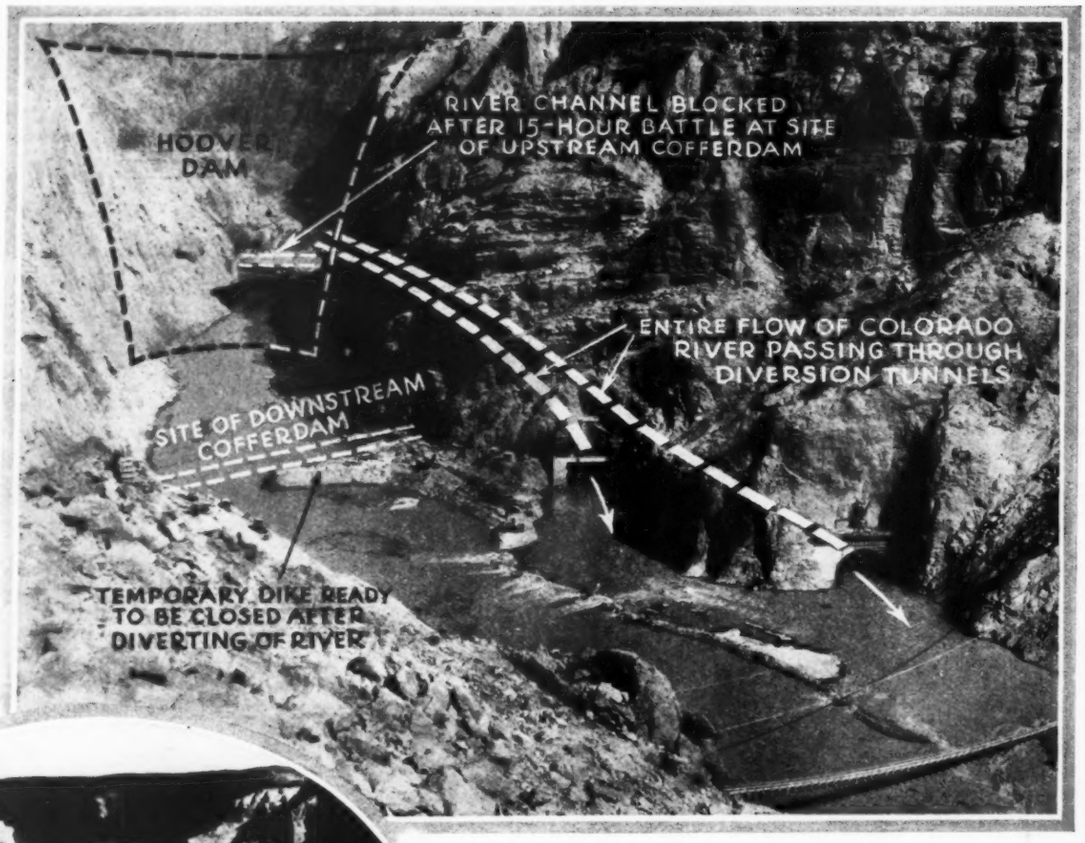
PILOT HOUSE ON ROOF FOR DRIVER

The car shown at the left, has been successfully tried out in Southern Germany. Seating forty-four passengers, it is capable of running a mile a minute, controlled by the driver who has a pilot house on its roof



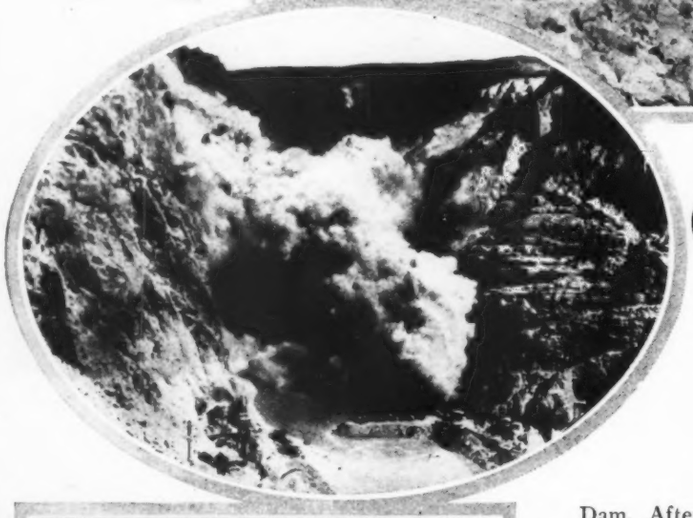
TWO CARS FORM WORLD'S FIRST STREAMLINED TRAIN

Designed for use on the road between Berlin and Hamburg, Germany, this streamlined train, consisting of two cars jointed together, can whirl along at the surprising speed of ninety miles an hour, powered by a huge Diesel motor. The train was developed after experiments with an air driven Zeppelin car


HOOVER DAM
RIVER CHANNEL BLOCKED AFTER 15-HOUR BATTLE AT SITE OF UPSTREAM COFFERDAM
ENTIRE FLOW OF COLORADO RIVER PASSING THROUGH DIVERSION TUNNELS
SITE OF DOWNSTREAM COFFERDAM
TEMPORARY DIKE READY TO BE CLOSED AFTER DIVERTING OF RIVER

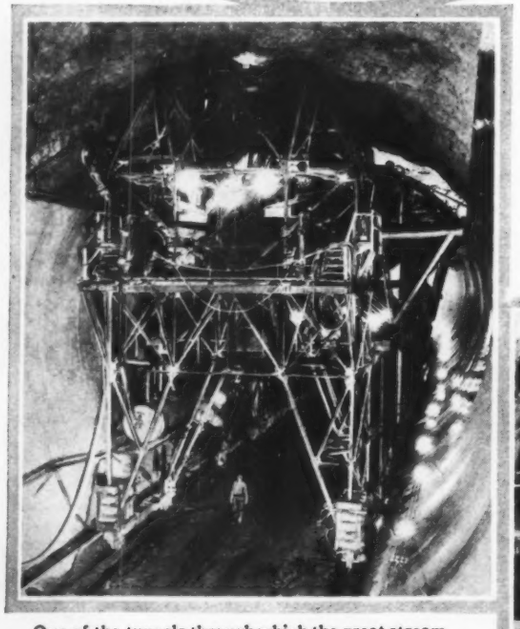
BOTTLING UP A RIVER

Unusual photograph at right shows where the Colorado was diverted to permit the erection of the Hoover Dam. This site will be pumped dry. Below, first move in the battle to turn the river. Blasts of dynamite hurled down rocks to choke up the bed

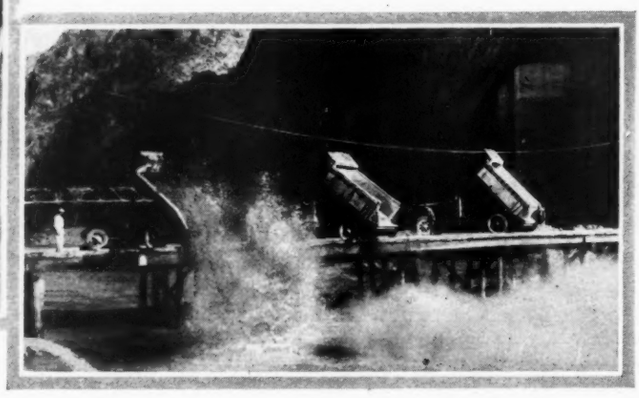


Course of Mighty River Changed

LIKE the booming of siege guns, the blast of dynamite echoed at noon recently through the Colorado River valley near Boulder City, Nev. The blast opened an epic battle between men and nature—the turning of the great river from its channel to clear the way for building Hoover Dam. After months spent in driving four fifty-foot tunnels through solid rock cliffs around the dam site, the finish was swift and spectacular. Explosions blew away temporary barriers at two of the tunnel mouths. Five thousand shots of dynamite choked the river channel with debris from the cliffs. Dump trucks in relays hurled load after load into the stubborn river to seal the barrier. At three in the morning, the men rested beneath floodlights, exhausted with their fifteen-hour fight—but it was won. The mighty Colorado flowed tamely through a pair of the tunnels, and two more on the opposite side remained in reserve to be used in carrying away the volume of water expected with the spring floods.



One of the tunnels through which the great stream now flows. Photo was taken as the final work was being done. Note man in the foreground



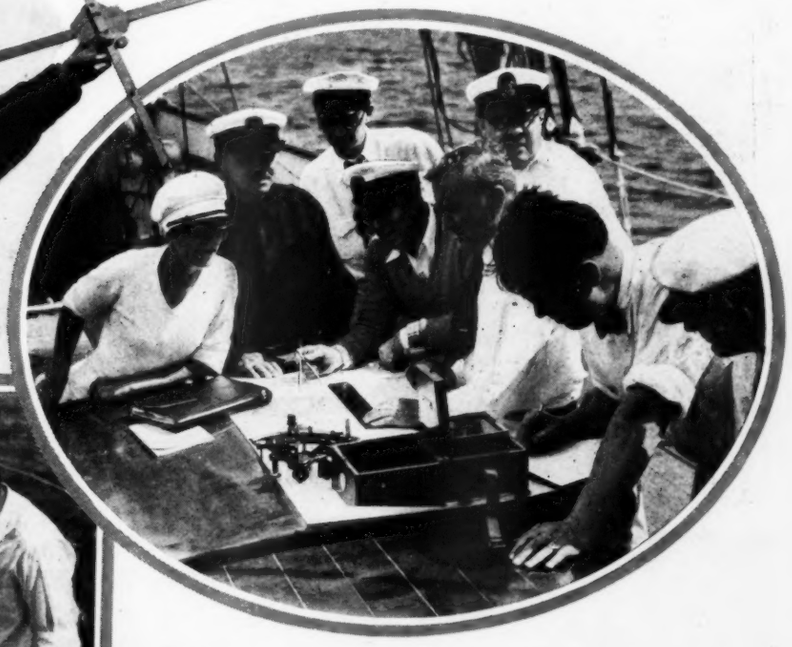
Dump trucks, working in relays, helped block up the bed of the river and won the fight to change its course. Entrance to tunnel can be seen in the right background

Making Mariners in College

Navigation, New Course at University, Is Taught Aboard Yachts

•

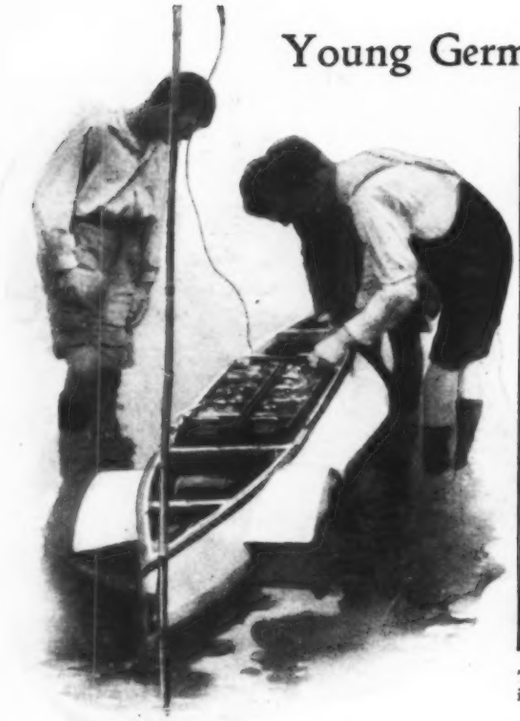
Student sailors from the University of Southern California, right, shoot the sun to get their position during search for a designated spot at sea. Below, left, a modern sextant and to the right of it a sun-shooting instrument similar to those used in time of Columbus

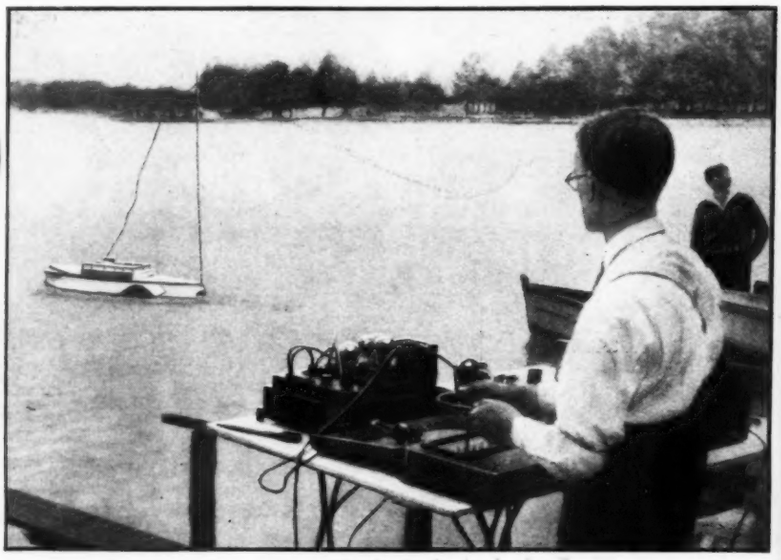


Having determined their position by sighting the sun, the class, above, is plotting the yacht's course. At left, boxing the compass

SEAMANSHIP is now being taught students at the University of Southern California. The class, on board seagoing yachts, is required to solve practical problems in navigation. Recently a yacht sailed away into the Pacific Ocean, heading for a spot previously determined by longitude and latitude. The next morning student sailors on two yachts set out to find the first vessel, charting their courses by their own unaided observations and computations. Each yacht reached the appointed spot during the afternoon with an error of two miles in one case and five in the other. Pictures on this page show activities of the navigators.

Young German Builds Radio-Controlled Boat





The boat seen out on the lake is controlled by radio waves sent out from the set which is stationed on shore. At left, installing the storage battery that powers the motor

A GERMAN schoolboy, Rudolf Weber, has astonished the residents of the little North Sea village of Neumark, Germany, by building a model boat that he can control by radio. By turning a device like a steering wheel, attached to a short-wave radio set, he makes the boat turn to left or right, and it will also start and stop at his radioed command. Storage batteries drive it. The feat is remarkable as young Weber built and assembled every part of the boat himself. He also constructed the radio set that controls the model and is now planning a larger apparatus for a passenger-carrying boat.

WHIRLING BLADES MOVE SNOW

Whirling screws in this snow plow, cut up the snow and remove it from roadway

WHIRLING screws clear the pavement of snow in a snow plow completed for use in California this winter. It will be put into service to keep open the Lassen Peak Loop Highway, which hitherto has always been blocked by the first heavy snowfall of the winter. The screws of the new plow clear the way while the machine proceeds at fifteen miles an hour and as a result it is able to clear any ordinary stretch of roadway in a remarkably short space of time in comparison with hand labor.

This spring-steel device, fitted inside a worn piston, restores its original shape

FERRY ON CABLES CAN CARRY ONE PASSENGER

EVERY passenger provides his own motive power in one of the world's queerest ferries, spanning the River Nidd in Yorkshire, Scotland. Sitting in a device like a boatswain's chair, suspended from a stout cable, he propels himself across by turning a crank.

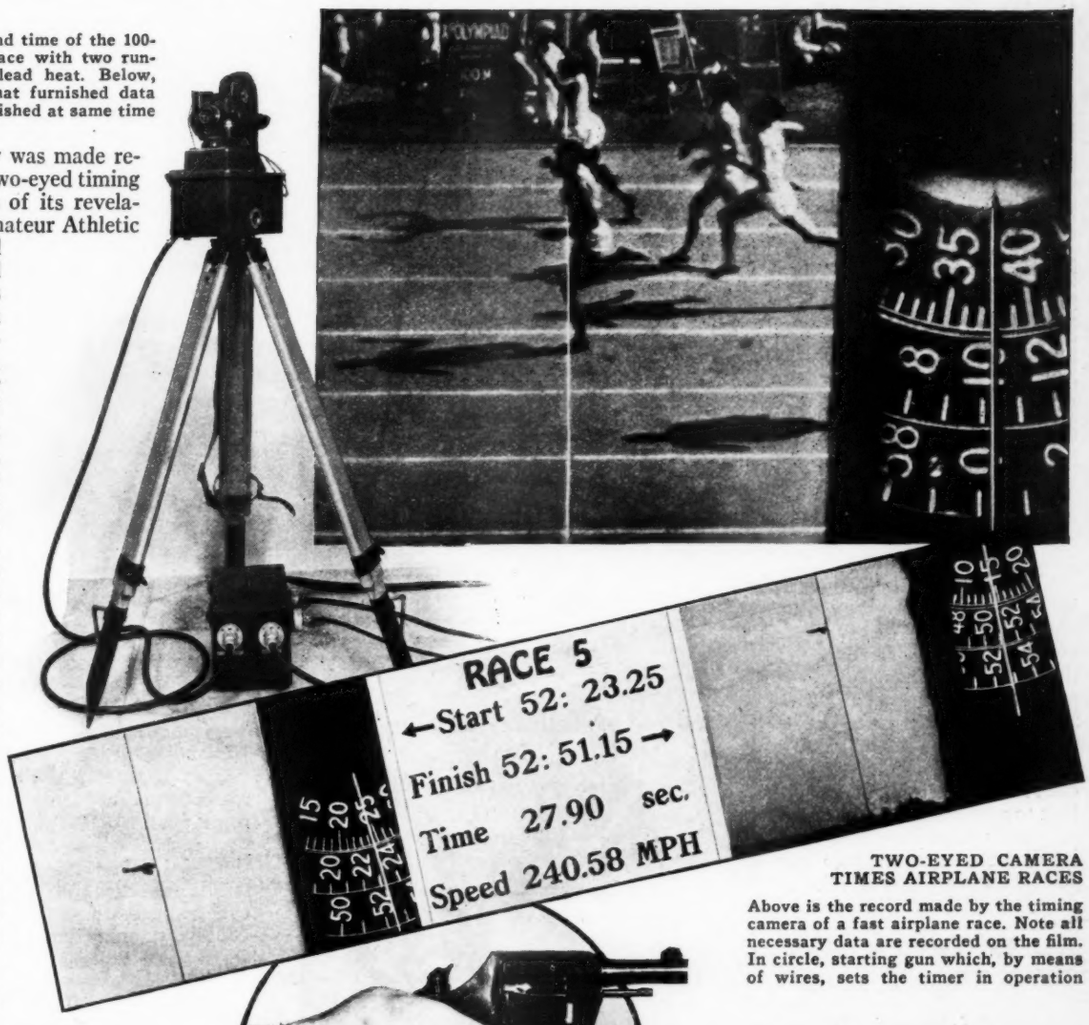
SPRINGS RESHAPE PISTON

WORN aluminum pistons in auto engines may be restored to their original fit, it is said, by the use of new piston expanders. When one of the spring steel devices is fitted into the interior of a piston, and its retaining clips are withdrawn with a screwdriver as shown, pressure at ten points expands the piston.

Sitting in this seat, suspended from cables, a passenger ferries himself across the river

Timing Camera Splits Athletic Honors

At right, finish and time of the 100-meter Olympic race with two runners in virtual dead heat. Below, timing camera that furnished data to show racers finished at same time



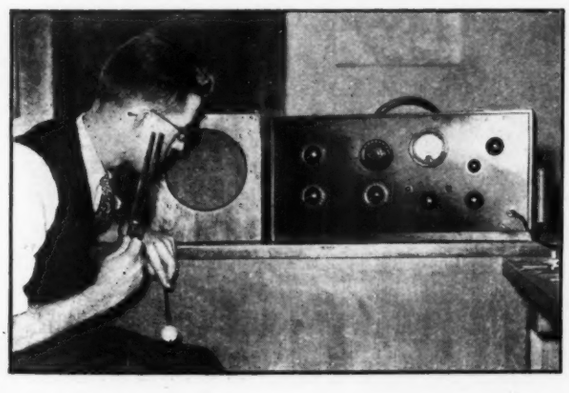
TWO-EYED CAMERA TIMES AIRPLANE RACES

Above is the record made by the timing camera of a fast airplane race. Note all necessary data are recorded on the film. In circle, starting gun which, by means of wires, sets the timer in operation

ATHLETIC history was made recently by a new two-eyed timing camera. On the basis of its revelations, the national Amateur Athletic Union has recognized as Olympic record holders two athletes who finished second in Olympic Game contests last summer. Sport fans remember the classic finish of the 100-meter track event at Los Angeles, when it was anyone's guess whether Eddie Tolan, Negro sprinter, or Ralph Metcalfe, his teammate, struck the tape first. The judges gave Tolan the verdict, their stop watches catching him at ten and three-fifths seconds, a new American and Olympic mark, equalling the world record. Films from the timing camera upheld the decision for Tolan, but showed that Metcalfe was only two inches behind! His chest struck the tape less than 1/100th of a second later than Tolan's.

With the films' vivid proof that the race was virtually a dead heat, the Amateur Athletic Union has now voted to recognize both Metcalfe and Tolan as co-holders of the record—an action unprecedented in the athletic world. It also voted Mrs. Evelyn Hall co-holder with Mildred Didrikson of the eighty-meter hurdle mark set by the latter, since here, too, the camera showed that there was not a hundredth of a second to choose between them. The two-eyed camera had its inception in an incident of several years ago, when G. T. Kirby, former president of the Amateur Athletic Union, saw a movie of an intercollegiate race and realized that second place should have been awarded to a man not even placed by the judges. He enlisted the aid of the Bell Telephone Laboratories in developing a timer not subject to human fallibility.

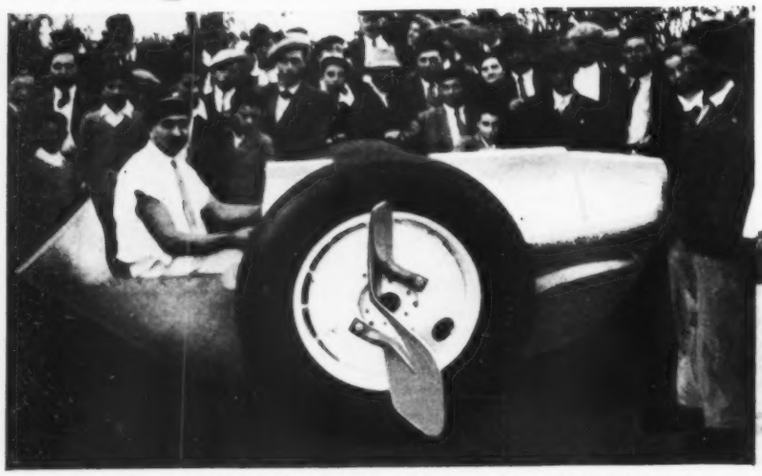
The result was the device first introduced experimentally last year. It comprises a high-speed, sixteen-millimeter motion picture camera capable of taking 128 pictures a second, and a set of electric clock dials registering time accurately in minutes, seconds, and hundredths of seconds. Through a double lens, the camera photographs both the participants finishing and the time of each picture as shown by the dials. Because of its extreme precision, due to the fact that dials of the timer, connected to the starter's gun, begin to revolve at the hammer's click, the new camera is now being used to time air races.



BUZZ LURES MOSQUITOS TO DEATH

WILL the complete home some day have its electric "de-skeeterizer"? Female mosquitoes hum to attract the stingless, silent males, and experts of the U. S. Public Health Service have just completed an instrument designed to duplicate their droning sound. Resembling a radio set in appearance, it produces a loud hum of adjustable pitch. Thus the experimenters hope to lure great swarms of male mosquitoes into traps. If the scheme works, it might curtail local breeding of the pests. The experiment was suggested by an incident at Lynn, Mass., where General Electric engineers were operating a powerful electric furnace. Its hum could be heard far away. Soon it was littered with the corpses of thousands of male mosquitoes. Apparently they had flown in from marshes attracted by what they mistook for a swarm of females.

Strange French Boat Can Crawl Out of Water



Above, new French boat which has wheels and can crawl out of the water and run under its own power on land. At right, the boat demonstrating its use in water

A QUEER boat that needs no dock, because of its amphibian proclivities, has been constructed by a French inventor. Two wheels at its sides enable it to crawl out of the water and up the shore under its own motive power. Paddles affixed to the wheels propel the craft when it is in the water. To steer it, a brake is applied to the left or right-hand wheel. The passenger sits in a small compartment at the rear, behind the engine.

MAKES MODEL OF 1,400-FOOT WINDMILL

VISITORS to the coming World's Fair at Chicago will see a twenty-one-foot working model, illustrated at right, of the "skyscraper windmills" proposed by Hermann Honnef, German structural engineer. To tap the power of upper-air gales, his bold scheme calls for the erection of 1,400-foot towers bearing wind-driven wheels more than 500 feet in diameter and capable of furnishing vast power (P. S. M., June '32, p. 21).

Twenty-one foot model of a skyscraper windmill

DUMP TRUCK HAS TWO FRONT ENDS

WITHOUT turning around, a new dump truck for road building travels forward or backward with equal ease. The driver's seat revolves, to face either way. Dual controls are provided, and a special transmission box permits four speeds in either direction. The illustration below shows the odd truck in use. The double drive, eliminating the necessity for turning around, speeds up the work.

SUPERHIGHWAY JOINS TWO BIG AMERICAN CITIES

A THIRTEEN-MILE superhighway linking two of the nation's greatest cities has just been opened between New York City and Newark, N. J. Starting at the New Jersey end of the Holland vehicular tunnel, its steel-and-concrete viaduct soars across rivers, marshes and cross-roads to permit high-speed motor traffic. By this route, mail trucks from the transcontinental airport at Newark will reach New York in a fraction of the time now required. Shown below in a striking aerial view, the $21,000,000 highway is called the costliest per mile ever built but the densely populated section it serves is said to justify the expense.

Air view of the superhighway of concrete and steel recently opened for New York and New Jersey traffic

NEW LIFE PRESERVER HAS TWO PROPELLERS

TIMID of sea travel because of his inability to swim, a Japanese lawyer of Los Angeles, Calif., has invented and patented a mobile life preserver. Hand cranks at the sides of the device turn a pair of diminutive propellers, enabling the wearer to advance at fair speed while remaining erect in the water. Thus a non-swimmer may reach a nearby shore without waiting to be picked up. The photograph above shows the inventor wearing his odd life preserver. Note the propellers and the hand crank that operates them.

Latest Locomotive Looks Like a Box Car

New style Diesel-electric switching locomotive now in use on British line

How modern advances in railway engineering have altered the contours of the iron horse is illustrated in the photograph above. This is the latest type of Diesel-electric switching locomotive put in service on British lines. Equipped with a 250-horsepower engine, this forty-ton machine does the work of eighty-ton locomotives.

HAND WORKED JACK PUSHES TREE OVER

Above, flexible chain saw cuts the big roots and, right, a powerful jack is then used to push the tree over

REMOVING a whole tree at once by pushing it down instead of sawing through the trunk, is made possible by a British jack invented for the purpose. The unconventional method leaves no stumps. To prepare a tree for removal, the ground around it is dug up and the thickest of the roots near the surface are cut through with a special chain saw with toothed, flexible links. The powerful jack is then placed against the trunk and the tree is pushed over.

CIRCULAR SAW CUTS OFF FINGER RING

WHEN a finger ring pinches too tightly, or must be removed in a hurry so that the doctor may treat an injury, the ingenious finger ring saw illustrated above comes to the rescue. It does the job without pain or possibility of injuring the wearer. The thin lower prong is first slipped between the ring and the finger, thus serving as a guard. Then a few turns of the wing handle rotate the circular saw blade and sever the ring in a jiffy. The tool is suitable for use by jewelers as well as by doctors or in an emergency, a layman can successfully operate it.

OLD WORDS GET NEW MEANING IN

Queer Trade Lingoes

"I run up to the calliope to match watches with the hoghead."

IF YOU could listen to the jargon of two freight trainmen, you might hear this:

"You may not know it, Snake, but you're lookin' at a stinger that was once in line to ride the cushions. If it hadn't been for a student tallow-pot—but I'll tell you about it:

"I've got Forty-four and she's a hot shot. Before we leave the yards, I take a run up to the calliope to match watches with the hog-head. I'm surprised to find a stude smoke-agent up in the cab taking orders from the bake-head."

Is this all Greek to you? Then listen to this translation:

"You may not know it, yard brakeman, but you're looking at a run brakeman who was once in line to be a passenger train conductor. If it hadn't been for a student fireman—but I'll tell you about it: I had number Forty-four and she was a fast freight. Before we left the yards, I went up to the engine to compare watches with the engineer. I was surprised to find a student fireman up in the cab taking orders from the regular fireman."

An engine was obviously called the hog because of its gluttonous appetite for fuel. The engineer who runs it is therefore the hog-head. When an engine is used in the switch-yards, it is appropriately called "the goat," because it butts cars around.

The caboose is called the "crummy" because it is occasionally infested with crums (lice). A disabled car is "a bad order." A freight yard clerk is a "mud-hop." When the engineer applies the air brakes he "wipes the gage" or they may say that he "cleans the clock."

Telegraphers' Lingo

EVEN though the telegraph operator in the railroad station is so closely associated with the railroad conductors and brakemen, he talks a distinct trade lingo of his own. Listen to him commenting to a fellow operator upon the performance of the telegraph man in the next town:

"He uses a bug, but it runs away with him. As a sender he's a lid. He can't read ahead and has combinations. But when he copies, no stuff is too fast for him. Last week I pasted him good, but I couldn't put him under the table. You never hear from him after he signs up."

Translated, this queer language means:

"He uses a semi-automatic key, but keeps it adjusted at a speed greater than that at which he can manipulate it properly. As a sender of messages he is poor. He fails to correct obvious typographical errors in the text before him, through lack of ability to read beyond the word he is engaged in sending. And he runs together certain characters, which makes them easily misunderstood. But when he receives messages, no speed is too fast for him. Last week I sent him something as fast as I could, but he was always able to keep up. He never interrupts for repetitions after he acknowledges his presence at the beginning of a message he is receiving."

Notice how many more words are needed to say in dictionary English what the operator's story tells so concisely. Trade lingoes are short cuts and time savers.

This tendency is carried to an extreme in the occasional use of figures. Thus "30" indicates the end of a shift or of the day's work, and has come to mean, also, death. One gets 30, or is given it. To the telegrapher "73" means "regards" or "best wishes," and "88" conveys "love and kisses."

The telegrapher's typewriter is called a "mill," and a sheet of the receiver's copy-paper, or a number of sheets interleaved with carbon, is a "book." An operator who pastes up the message on a blank form from strips of tape from the automatic printing receiver is called a "paper hanger."

Abbreviations pass for some words, thus: "dux" for "duplex," "mux" for "multiplex," and "peter" for "repeater," short cuts that save them time.

Ham Jargon

IF YOU aren't one yourself, you need to be told that a "ham" is a radio amateur. Since his language is generally talked via the air in dots and dashes, he has been driven to cut everything down to the bones. "Old man" becomes OM; "young lady," YL; "nothing doing," ND; "see you later," CUL; and "fine business," FB. When he meets his hams face to face, they will still converse in the same code language. Thus, one "brass-pounder" might tell another:

"I couldn't get on the air last night; nursery QRM (interference). My kid had a cough that sounded like sixty cycles on the plate, and I had to go for the doc to do some trouble-shooting."

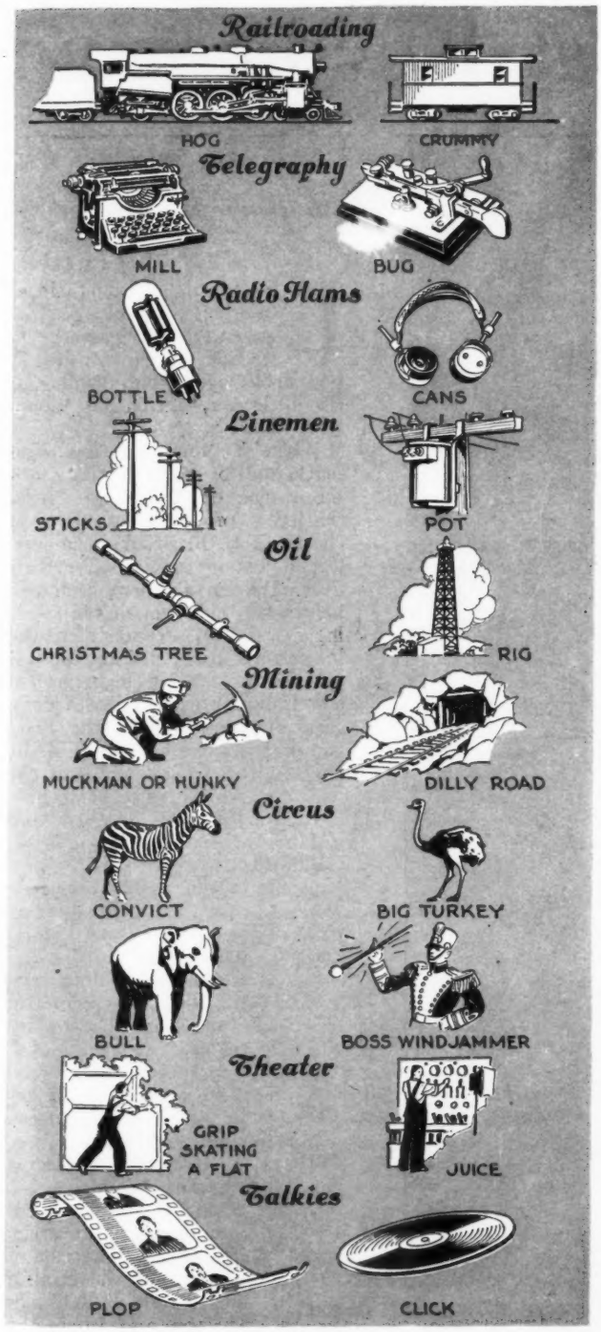
Pieces of apparatus are called by nicknames or abbreviations, or manufacturers' type numbers. Vacuum tube becomes "bottle"; rheostat, "rheo"; head phones, "cans"; and resistance box, "stove." The sending set is often given a feminine name of endearment such as "Old Betsy." It is never masculine. QRT is "shut up." QSA is "loud," or "loud-mouthed." To hold two-way communication is "to work." One amateur speaks of another's "fist" as "in the mud," when his sending technique is careless and sloppy.

Under the Big Top

ONE of the most colorful lingoes talked in America is spoken by the circus. If you should get a job in one, you will at once be called "First of May," the nickname of all newcomers to the ranks.

THIS ARTICLE TELLS WHY . . .

An engineer is a hog-head
A new circus hand is First of May
Electric current is hot stuff
A yard switchman is a snake
A circus elephant is a bull
A fast freight train is a hot shot
A movie electrician is a gaffer
Circus monkeys are old folks
A freight yard clerk is a mud hop
A circus performer is a finker



Drawings to help you translate trade jargon into English

Workers Coin Original Phrases as Short Cuts in Giving Orders or in Describing Features of Their Jobs

By Gaylord Johnson

If you are lucky enough to make friends with an old trouper, he will be glad to educate you.

"Listen here, First of May!" he might say. "Let me wise you up on 'mud opera patter!' You was just a gillie last week. (Town person.) Now you've joined out with the gypsy camp. Talk like you had! Don't go spilling gillie-talk all over the lot. Them ain't zebras, ostriches, hippos, camels, hyenas, monkeys, and elephants. They're convicts, big turkeys, hogs, humps, grave-diggers, old folks, and bulls. It ain't the side-show and the menagerie tent. It's the kid-show and the cat-house. When we make parade, the band doesn't play cornets, clarinets, and tubas. They play frying pans, gob sticks, and bull horns. The brass and snare drums are big tub and little tub, the cymbals are pot lids, and the drumstick is the potato-masher. The band leader is the boss wind-jammer."

As your education in circus lingo proceeded, you would learn many more new terms for familiar things. If a trouper remarked, "Flag's up on crumb castle!" you would know that it was time to eat in the cook-house. If the circus made a long daytime rail jump, so that the cook-house couldn't be set up, you would be handed a box-lunch called a "dukie." Such a trip is dubbed a one or two dukie run, as the case may be.

You would soon call people who don't buy tickets to the big show, preferring merely to enjoy the free sights on the lot, by their right name—"lot fleas." You would call any performer a "finker" and any bare-back riding horse a "rosin-back." A horse condemned to die for "cat food" is a "Navajo." Show horses are "ring stock"; work-horses, "baggage stock."

On a sweltering hot summer day you would say, "It's a great juice day!" You would get used to "getting up in a tunnel." (Starting work before dawn.) You would also know what the "equestrian director" (not the ringmaster) means when he says, "Give 'em Brown's cow!" (Cut the program short.)

A Lineman Talks

IF WE seek some country roadside on a morning when a gang of telegraph linemen are arriving on the job, we shall hear an entirely different kind of lingo.

A lineman is a "hiker." But he must begin at the bottom, start as a "grunt" or ground man. From this lowly job, he may rise and "win his spurs," that is, become a "pole-hiker," wearing steel climbing irons. On top of the sixty-foot "sticks," he must then learn caution in handling the "hot stuff," or live wires. He must also beware of "Maw Bell" (telephone) wires, for they are "grounded." If his body gets hooked-up with them and the "hot stuff," he will be burned or killed in mid-air. He is safe only as long as he "stays in the clear," that is, handles only one hot wire on a pole.

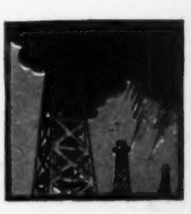
Here is a line gang arriving on a job. Listen to them a moment. The boss says:

"Shorty, you and Jim take that stick (climb that pole) and hang that 15 K.V.A. pot (transformer). You can have Harry and Jabs for grunts. Then you take the grunts and frame, roof, and set this other stick. (Cut the top of the pole on a bevel, make a mortise for the cross arm, and set the pole.)"

When the pole is lined up properly in the hole, the boss shouts, "Give her mud!" and the dirt is tamped in to hold the stick in place. When the rain stops their work, the men sit under a tarpaulin and "build high lines," in other words, tell tall stories of their alleged former experiences in building lines in record time, or other unusual accomplishments with the sticks.

Oil Fields Chatter

A WORKER on an oil drilling gang, exchanging experiences over his dinner pail, would say:

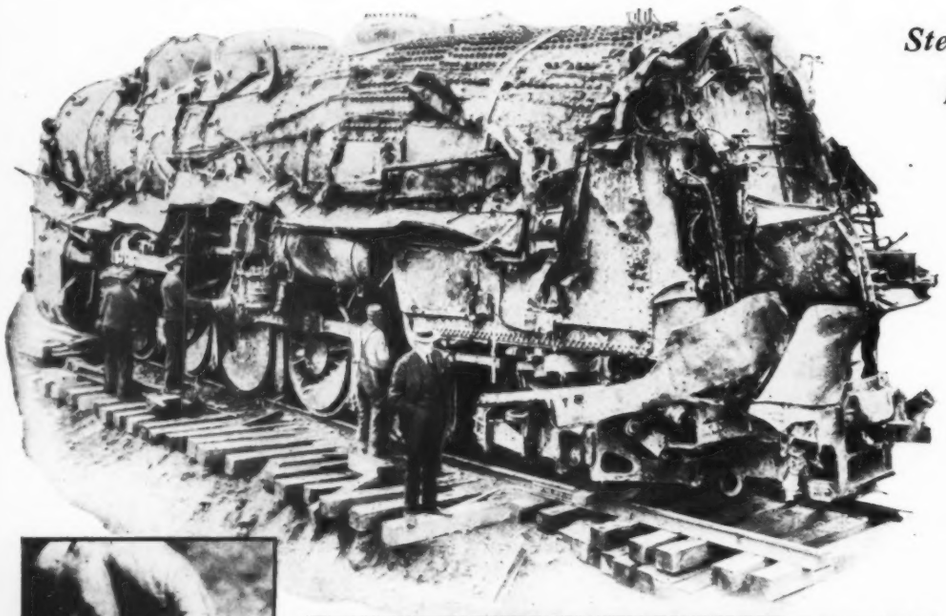


"I was workin' in a post-hole territory with a mail pouch outfit. They was a sheep-herder, a prune-picker, and a long-horn. We cuts the ditch to 2,000 when she comes in and runs barefoot, until we have to bean her. Later, when she stops flowing, we puts her on the beam, and she sands up on us."

This is oil-field code language for the following narrative:

"I was working in shallow production oil land (with wells less than 2,500 feet deep) with a gang using a cable-drilling machine. (Called Mail Pouchers from their widespread use of this brand of tobacco.) There was a man from Wyoming, a Californian, and a Texan. We drilled the well to 2,000 feet, when it started flowing oil. It ran without any lining in the part of the bore passing through the productive oil sands, until we had to put in a plug with *(Continued on page 98)*

Magnet Finds Lost Locomotive



Steam Shovels Salvage Big Engine Buried By Flood

LOST—a 375,000-pound locomotive! One of the biggest freight engines in Pacific service vanished, a few weeks ago, from a siding at the little way-station of Woodford, Calif.

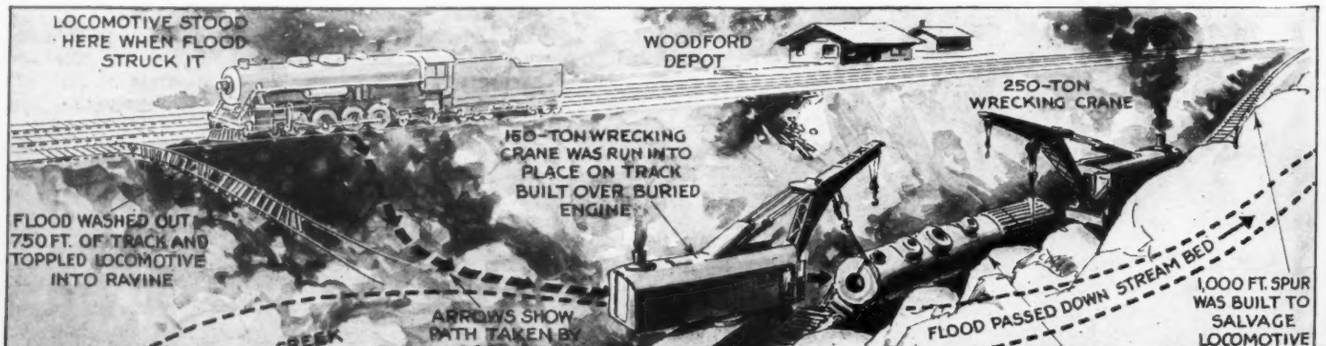
When a mountain cloudburst sent a wall of water roaring down the ravine of Tehachapi Creek, the crew of a freight train in charge of E. B. Brooks, engineer, leaped just in time to save their lives. The embankment crumbled before the onslaught of the swirling waters. A second later, the locomotive toppled into the ravine. Watchers on high ground saw it bumped along like a chip, then disappear. When the flood had passed, a fresh-laid bed of silt covered the stream bed and the engine was nowhere to be seen.

Railroad officials recalled that a Los Angeles engineer, W. W. Galbraith, had successfully used a magnetic needle to find electric transformers buried in a California dam disaster some time before. He was commissioned to find the locomotive. Walking along the stream bed with his needle in hand, Galbraith stopped at a point where it pointed straight down, apparently attracted by a mass of buried iron. Steam shovels uncovered the locomotive fifteen feet below the surface.

The big engine seemed valuable enough to justify a salvage job that cost $35,000, and is considered a master feat of engineering. Track crews under the direction of H. S. Wall, the line's mechanical superintendent, built a thousand-foot spur to the spot where the engine lay. Two wrecking cranes hoisted the locomotive to a cradle, and dropped it on the spur, whence it was towed in to the home shops and repaired for service.

At top, engine, battered by fall down embankment when swept from track by a cloudburst, is lifted out of mire and returned to track. Above, magnetic needle used to find the locomotive

At right, lost locomotive as it looked when steam shovels uncovered it and the big cranes were ready to lift it out of the ravine. Below, drawing shows how flood carried the engine off the tracks and how engineers solved the problem of getting it back in service


LOCOMOTIVE STOOD HERE WHEN FLOOD STRUCK IT
WOODFORD DEPOT
250-TON WRECKING CRANE
150-TON WRECKING CRANE WAS RUN INTO PLACE ON TRACK BUILT OVER BURIED ENGINE
FLOOD WASHED OUT 750 FT. OF TRACK AND TOPPLED LOCOMOTIVE INTO RAVINE
TEHACHAPI CREEK
ARROWS SHOW PATH TAKEN BY LOCOMOTIVE
FLOOD PASSED DOWN STREAM BED
1,000 FT. SPUR WAS BUILT TO SALVAGE LOCOMOTIVE
"LOST" LOCOMOTIVE WAS FOUND BURIED 15 FT. DEEP AT THIS POINT, 150 FT. DOWN STREAM

Flowers

"GROWN" IN A DAY FOR THE Movies

Only half a day was required to make this big bouquet of rhododendrons in the flower laboratory but, chemically treated, it will last for over four years

Above, gluing a paper leaf to a cactus blossom of crepe. At left, a movie garden scene with all the plants and flowers looking real but made by hand

PHOTOS, COURTESY METRO-GOLDWYN-MAYER

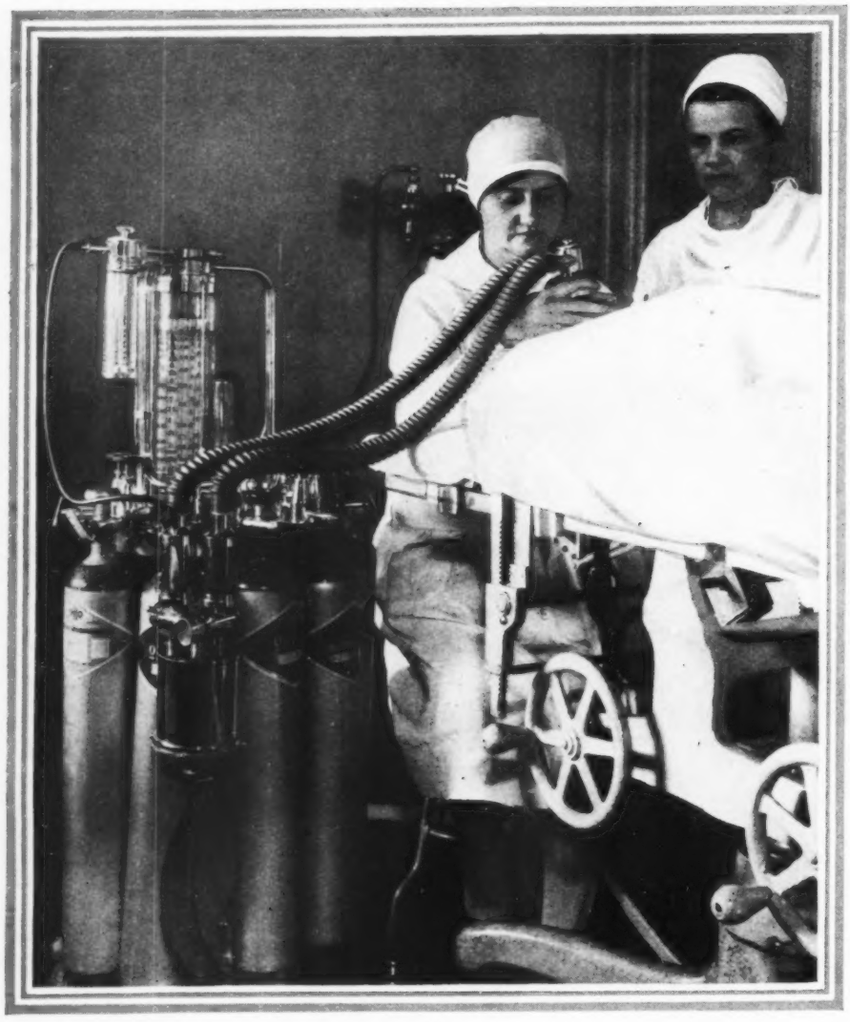
WHIRLING WHEEL WIRES FLOWER STEMS

After the flower, for use in the movies, has been shaped and colored, the steel stem is inserted in the center of this wheel and as it spins it binds petals and leaves to the stem

RHODODENDRONS, roses, thorny cacti, fruits, and stately palms grow in half a day in a movie flower laboratory. Steve McDonald, plant expert, developed the process of building realistic plants and fruits quicker than a florist could cut and deliver fresh products—and at one-twentieth the cost. With a pot of paste and a spinning wheel, McDonald takes steel wires, tissue paper, rubberized cotton, silk, and fine threads and creates plants and blossoms to order. On the screen, no one can distinguish them from actual flowers.

To make these flowers, McDonald takes a real plant and pulls it apart. Then he makes patterns that match exactly each leaf and petal. After cutting his patterns, he makes additional duplicates, the petals from rubber, leaves from dyed linen. He colors the petals, splits them, and glues them together again to shape them properly. From this point his spinning wheel completes the building of nearly all flowers. He inserts a steel rod into the center of the wheel, and as it spins two threads wrap themselves around the stem. After the plants are dipped in a chemical solution, leaves and stems retain their life and color for several years.

Safe Pain Killing Drugs BRING NEW ERA IN *Surgery*



SAVING THE ANESTHETIC. Here is the very latest mechanical means for administering an anesthetic. Through one of the heavy tubes going to the patient's mouth flows the purified gas which is inhaled. As the patient exhales, the gas-laden breath goes into the other tube and is purified by passing through a soda lime container so it can be used again

HERE are three dramatic news-flashes from the world of astonishing, modern surgery:

In a New York hospital, a patient is wheeled into the operating room holding a newspaper in one hand. All during the operation, he calmly reads the news. He is completely conscious, yet he feels no pain.

In Pennsylvania, a famous seventy-year-old surgeon performs a major abdominal operation upon himself, his brain alert, his hands skillful, yet the lower part of his body deadened to pain.

On Long Island, a patient carries on a conversation with the surgeon during a forty-five-minute operation in which his skull is opened and splinters of bone removed from his brain.

Amazing? Unbelievable? These are only scattered examples of the bewildering achievements of the newest anesthetics. It is no longer necessary to lose consciousness during an operation. You can remain awake and still be entirely free from pain. Or, if you prefer to go to sleep until it is over, late developments in technique increase your safety while under the anesthetic.

The story of deadening the human body to surgical pain goes back thousands of years. Egyptian surgeons along the Nile hit patients on the head in just the proper place and operated on them while they were unconscious from the blow. In the Middle Ages, powerful thumbscrews clamped down on nerve-trunks to paralyze a limb during amputation. Vapor from sponges containing lettuce, opium, hemlock and other drugs was employed in the Fourteenth Century to stupefy patients. Then, in 1776, Anthony Mesmer attained fame in Paris by hypnotizing sufferers before they entered the operating room. But the most frequent method of preparing a patient for surgery, even up until less than a century ago, was to give him alcohol until he was intoxicated. Then, while four powerful men held the writhing victim, the operation was performed, obviously under difficulties.

Under such conditions, delicate work was impossible. Major operations were out of the question. The chest, the head, the abdomen were virtually unexplored territory, from the surgical viewpoint, until after the introduction of anesthetics. Only then did the surgeon have at his disposal sufficient time to attempt the marvels we now associate with surgery—dramatic feats like the following recently reported from the middle west:

A beautiful, six-year-old child, after an accidental fall, was attacked by fits. Doctors were unable to effect a cure; specialists could not discover the cause; ordinary diagnosis failed to reveal any obstruction or clot upon the brain. A great surgeon was called in. He began his work like a detective searching for clues. Noting that the contractions always began at exactly the same spot on the child's face, he prepared for an unusual operation.

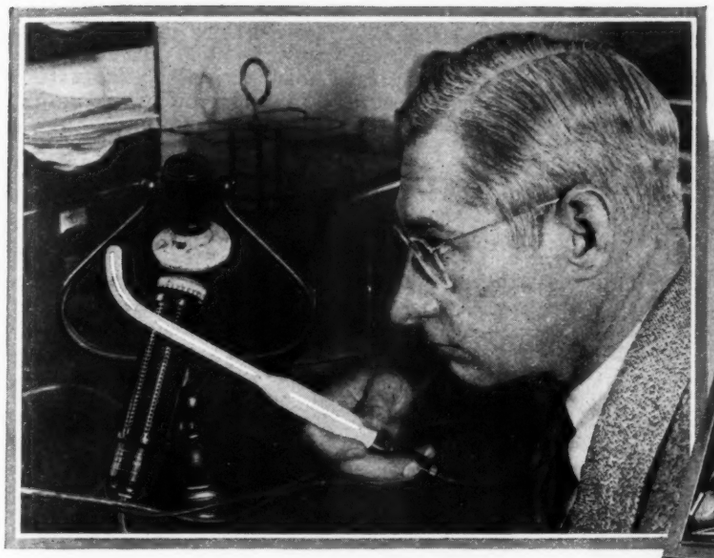
Near the rear of the skull, he made a small opening and then gently touched the brain over a gradually widening area with an electric needle. Each time the needle came in contact with the gray mass of nerve-cells, a quick contraction of the muscles resulted somewhere in the child's body. When this contraction took place at the exact spot where the fits began, the surgeon examined the interior of the skull near the spot at which the needle then touched the brain. He found a bit of scar tissue. When it was removed, the patient made a complete recovery. But for the magic of modern surgery, the child would never have been normal again.

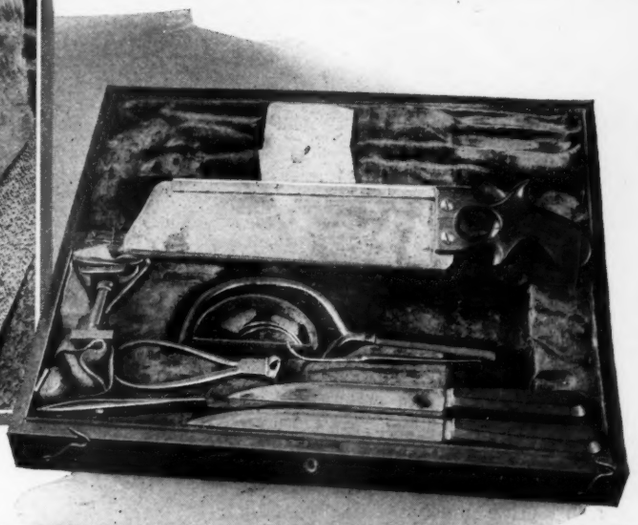
That operation required nearly an hour to perform. Less than ninety years ago,

This Article, Third of Modern Surgeons,

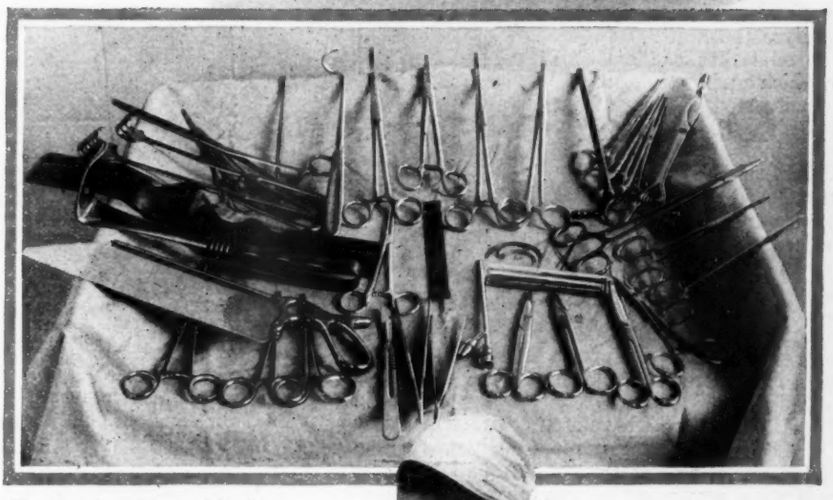
By

FREDERIC DAMRAU M.D.

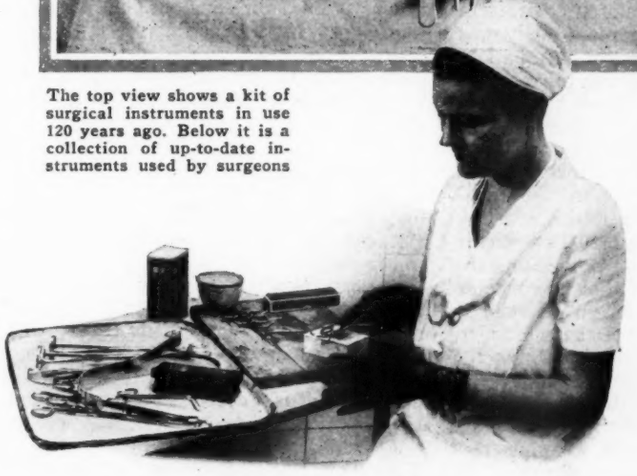




Sealed in a vacuum in the tip of this retractor-shaped instrument is a cold light which will illuminate an incision without burning the flesh



The top view shows a kit of surgical instruments in use 120 years ago. Below it is a collection of up-to-date instruments used by surgeons



After each operation, the nurse carefully cleans each instrument by laying it on a cake of abrasive soap and rubbing over it with a cork attached to her hand

the limit of time for any operation was five minutes. Unaided by anesthetics, the human system could stand the pain no longer. Then, on October 16, 1846, a Boston dentist, Dr. William Thomas Green Morton, demonstrated the use of ether at the Massachusetts General Hospital and brought in a new era in surgery.

Morton had spent years experimenting with various chemicals before he turned to ether. At that period, lecturers on chemistry sometimes put on ether frolics to demonstrate the peculiar powers of the drug. Volunteers from the audience would inhale the fumes until they were apparently intoxicated. Morton, as well as others, noticed that these subjects appeared to feel no pain when they bumped into walls or fell over furniture.

He began his tests of ether as an anesthetic by trying it out on birds, mice, and a pet water spaniel. Finally, on September 30, 1846, he shut himself in his room, sat down in his dental chair, and began to inhale ether from a saturated handkerchief. He had determined to make a conclusive test upon himself.

"I looked at my watch," he wrote later, describing what followed, "and then lost consciousness. When I recovered, the sensation was like a nightmare. My limbs were numb. I thought for a moment I should die. At length I felt a slight tingling of blood at the end of my third finger. I made an effort to touch it with my thumb, without success. At a second attempt, I touched it. There was no sensation. Gradually I raised my arm and pinched my thigh. There was little sensation. Finally, I regained full consciousness and looked at my watch. I had been insensible between seven and eight minutes."

Two weeks later came the dramatic moment at the General Hospital when he demonstrated his discovery. The operating room was high up under the eaves of the building. It had been located there so screams of the sufferers would not disturb the patients in the wards below. The assembled doctors were skeptical. Many openly expressed the opinion Morton was a faker.

Another dentist had previously tried to demonstrate an anesthetic, had failed, had been hissed out of the same room, and had committed suicide. Morton knew if he failed, his practice would be ruined; if the patient died, he would face manslaughter charges. Yet he went courageously ahead. At the close of the successful operation, performed by Dr. John C. Warren, this famous surgeon turned to his colleagues and said in a hushed voice:

"Gentlemen, *this* is no humbug."

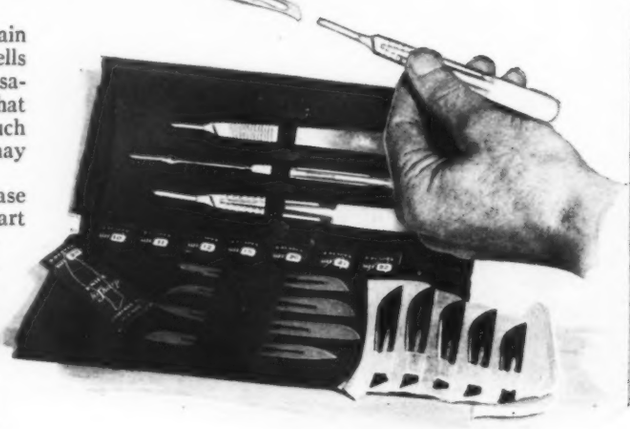
Two years later, chloroform was introduced in Europe and not long after, nitrous oxide, or laughing gas, came into use. The foundations of painless surgery had been laid.

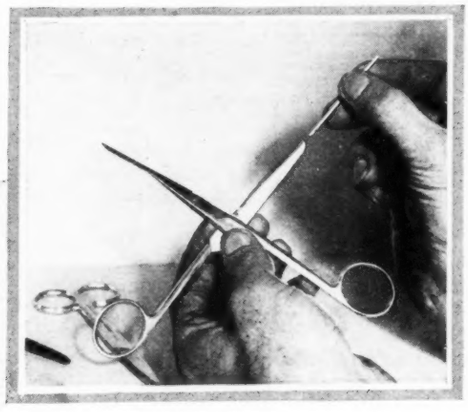
While chloroform was widely used in Europe, it was never popular in the United States. Carried by the red blood corpus-

in Our Series Dealing with Achievements Describes Many Recent, Amazing Operations

Retractor instruments into which are set tiny electric lights. When the retractor is put inside an incision, the wound is fully illuminated with no obscuring shadows

REMARKABLE INSTRUMENTS USED BY SURGEONS





Delicate surgical instruments are provided with removable blades as shown at the left. Above, even the blades on scissors can be changed, a new one sliding on in a groove

cles, it reaches the brain and deadens the cells which record pain sensations. The danger is that even a little too much in the blood stream may paralyze the heart.

I remember one case in which a patient's heart actually stopped during an operation I was performing. It came like a thunderbolt out of a blue sky. As the head nurse later described it, the patient became coal-black, I snow-white. Only split second emergency measures saved his life. That was the last operation I ever performed in which I used chloroform as the anesthetic.

THE only time I have seen chloroform used in an operating room lately was in the case of a short, thick-necked patient who was a heavy user of both tobacco and alcohol. Alcoholics are always hard to get under the anesthetic and smokers have to quit smoking for from one to two days before an operation to rest their throats. Otherwise, the ether may burn the membrane and cause coughing. In this instance, the doctor administering the anesthetic first tried nitrous oxide. It proved unsatisfactory. He tried ether. Violent coughing was the only result. In the end, he had to use chloroform to get the patient under, after which ether was employed for the remainder of the operation.

The effect of ether, the most widely-used anesthetic, is similar to that of alcohol, depressing the brain. It produces a deeper intoxication than alcohol but one which does not last so long. Laughing gas, or nitrous oxide, brings unconsciousness by combining with the red corpuscles and preventing them temporarily from carrying enough oxygen to the brain.

In present anesthetic technique, nitrous oxide and oxygen are used until the patient has lost consciousness. Then ether is administered during the hardest part of the operation, finishing off with nitrous oxide again. Less stomach disturbance results than when straight ether is employed. Nitrous oxide is the safest anesthetic; chloroform the most dangerous but the most efficient; ether the best for all-around work.

Because ether is an intoxicant, the human system develops a tolerance for it just as it does for alcohol. The most extraordinary instance of this sort is the case of Capt. Albert Froidevoix, a forty-two-year-old French soldier of the Foreign Legion. With a total of fifty-five operations, he holds the world's record.

Twenty years ago, Froidevaux was cutting down a poison bamboo in French Indo-China. A small sliver entered one finger. A week later, the finger had to be amputated. Gradually, the mysterious poison seeped through his system necessitating operation after operation, until today arms and legs have been completely cut away. As a result of his many trips to the operating room, his system has become so used to ether that three times the ordinary amount is required to make him lose consciousness.

IN ADMINISTERING ether, there are four stages, each with its separate problems. In the first, the patient is stimulated. His breathing becomes deeper. The pupils of his eyes grow larger. At this time, the amount of ether must be regulated carefully. Too much will burn the throat and result in coughing. Patients who wear beards require special masks to prevent air from leaking in around the bottom of the ether cone and interfering with the action of the anesthetic. The way to go under an anesthetic with the least difficulty is to breathe rapidly and deeply.

During the second stage, the patient becomes excited. He may shout or sing or struggle. Alcoholics are particularly susceptible. I remember one giant longshoreman who was six feet and a half tall and accustomed to drink whiskey like water. I thought I had him safely under the anesthetic when he leaped off the operating table, hurled me half across the room and was pummeling me unmercifully when orderlies rushed in and pulled him off.

The general rule is: The stronger the patient, the greater the excitement during the second stage. Invalids, who have been confined to bed for long periods, require the least anesthetic and women are usually easier to anesthetize than men.

A few years ago, a German diplomat who stood more than six feet tall and weighed 300 pounds, had an acute attack of appendicitis on the *Aquitania* at three A. M. during a terrific storm at sea. White water was rushing the length of the deck, smashing six-inch rails and bending steel plates forward of the chart room, when the chief surgeon, Dr. B. Sydney Jones, decided to operate.

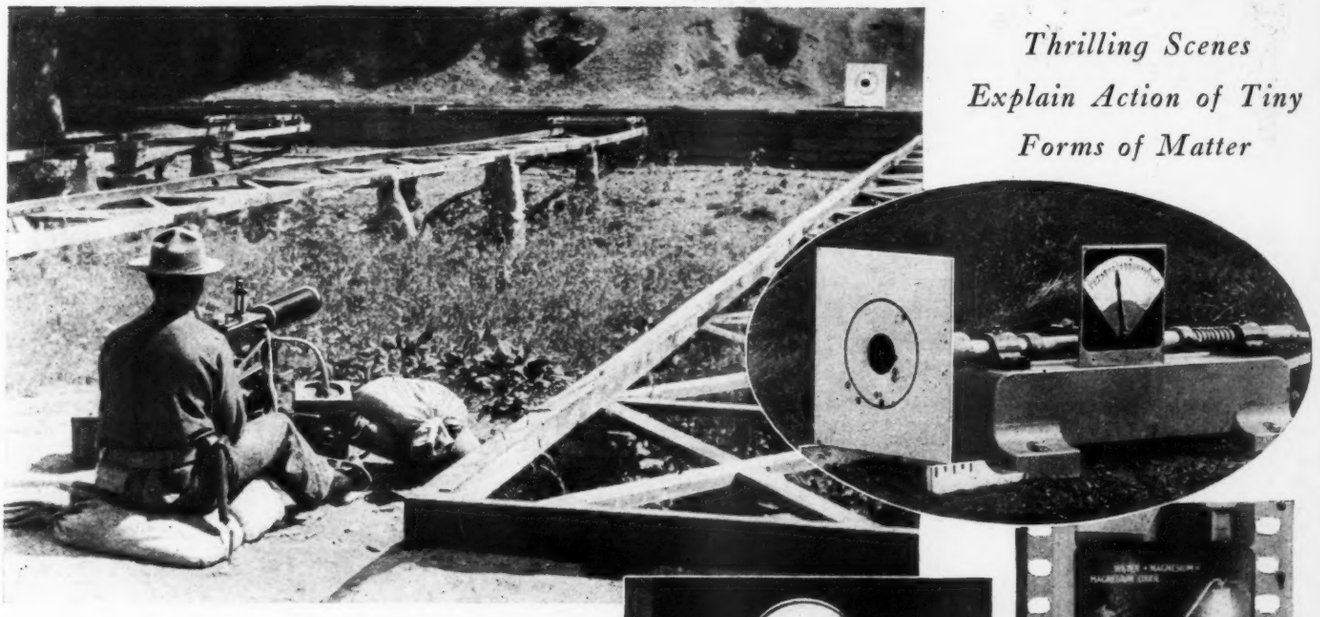
PRACTICALLY everyone on board was seasick. With half a dozen volunteer helpers, Jones strapped down the huge patient and administered the ether. Then, one by one, the assistants staggered away, attacked by seasickness. Fortunately, a sufficient number remained to restrain the big diplomat during the excitement stage, but, when the actual operation began, Jones was left with a single helper. In spite of this, he completed the operation successfully, and later, when the diplomat returned to Europe on the same boat, he thanked him for saving his life.

The excitement during the second period may be increased by an inexperienced surgical team, through the patient overhearing something said after he is apparently unconscious. Quiet should be maintained until the third stage is reached. Some anesthetics make hearing particularly acute. With nitrous oxide, for instance, the sense of hearing persists after sight, smell, touch, and taste have been lost.

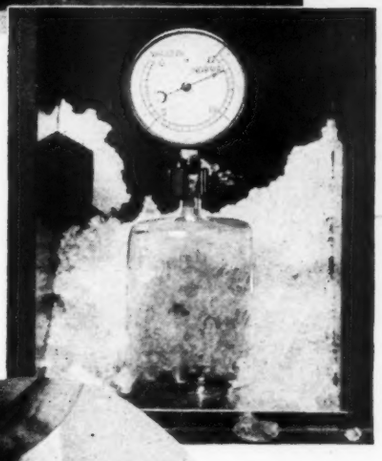
In the latter part of the second stage, the muscles become relaxed. The breathing grows regular, machine-like, averaging between twenty-five and thirty inhalations a minute. Patients perspire freely. In some hospitals, the ether is passed through a bottle filled with hot water before it reaches the patient to keep the vapor from chilling him. *(Continued on page 102)*

Life of Atoms Shown in Movies

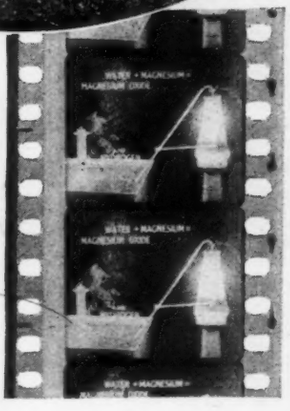
Thrilling Scenes Explain Action of Tiny Forms of Matter



Demonstrating the action of molecules of gas. The machine gunner rains bullets upon the target to simulate the impact of molecules against the walls of its container. In oval, a special gage back of target, registers the force of the striking bullets



As gas is chilled, the movement of its molecules slows down. This is shown in ice-filled chamber of gas with gage to give the pressure changes

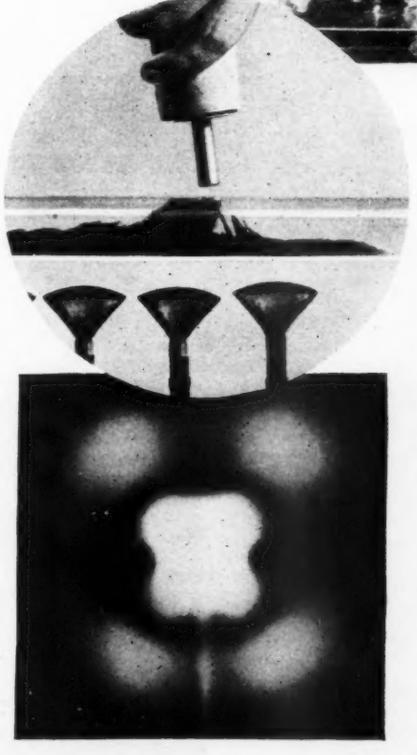


In a steam filled flask, magnesium ribbon is electrically ignited. It burns in pure water vapor. Hydrogen is freed and is collected in cylinder at left

ATOMS are in the movies now! They dance and collide, marry and divorce one another, in a pair of new motion pictures entitled "The Molecular Theory of Matter" and "Oxidation and Reduction." Made under the auspices of the University of Chicago, and intended especially for use in the classroom, the unusual films employ all the artifices of the talkies to show both laymen and students how atoms behave.

You see a machine gunner pull his trigger, and a hail of bullets pounds a heavy steel plate. A gage needle behind the target swings over and stays there, held by the force of the rapid succession of impacts, until the fusillade stops. By this vivid analogy, one of the films illustrates an otherwise difficult concept—how individual molecules of gas, bombarding the walls of a closed vessel, create a steady pressure by the cumulative force of their impacts. Similarly other traits of atoms and molecules, difficult to describe in words, are made understandable, with the aid of microscopic and time-lapse photography, animated drawings, and comparisons with familiar objects.

To illustrate "oxidation," the second film brings a forest fire into the room. A blowtorch burns its way through steel plate. The operation of a coke oven is shown. The rusting of metal is explained as still another example of oxidation, a chemical process not limited to actual burning. Sometimes the process can be run in reverse; then chemists call it "reduction." Thus the film shows how iron rust can be turned back again into pure iron by placing it in a glass tube above a battery of burners and blowing hydrogen gas over it. Proof of the feat of chemical sleight-of-hand is given when an electromagnet, which will not attract pieces of rust, picks up the fragments of iron.



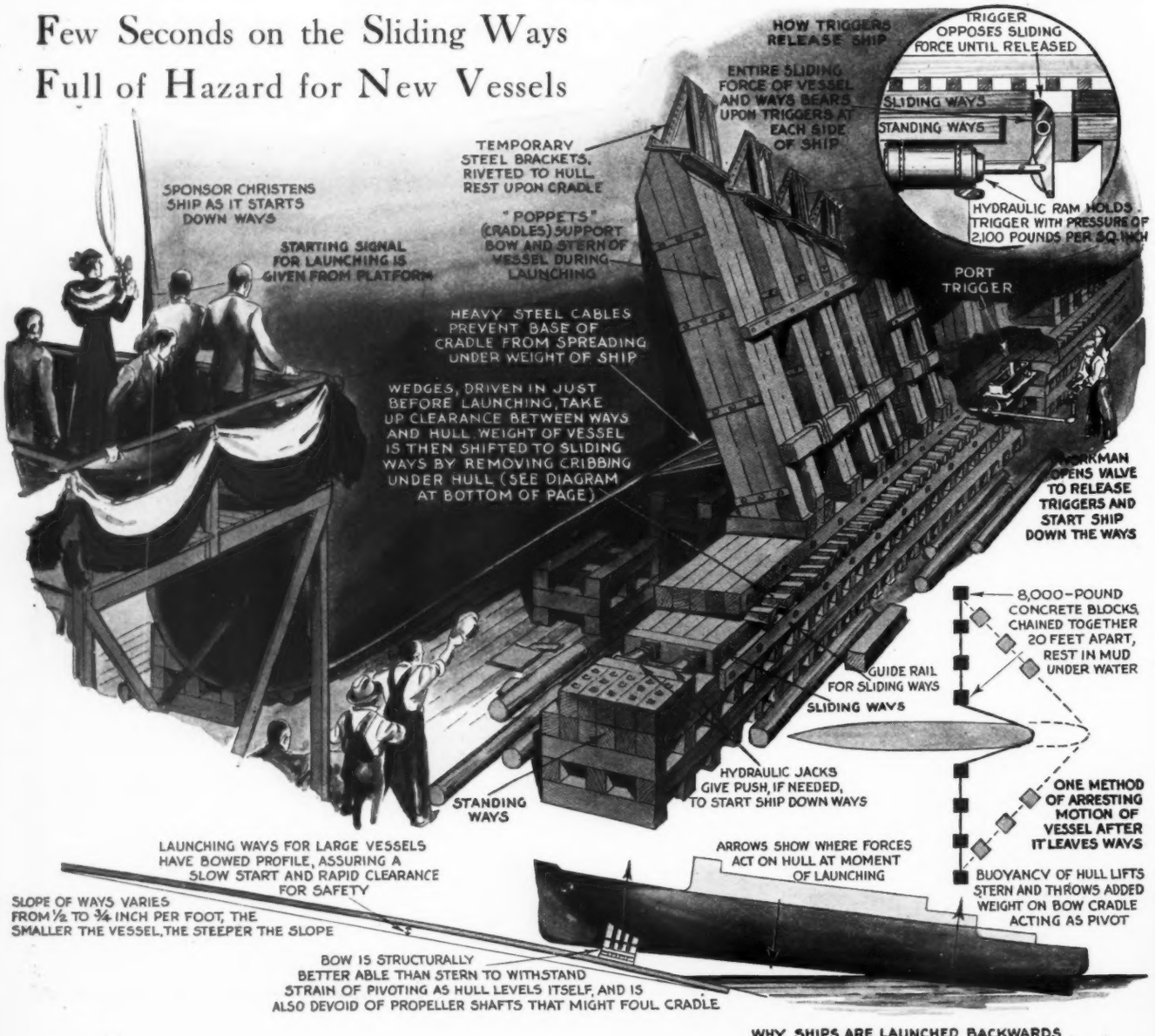
In circle, iron rust is changed back to iron so magnet attracts it. Above, hydrogen atom as fuzzy ball surrounded by its vague cloud

Scientists hail the films as a new, vivid way to teach the fundamentals of natural law. University of Chicago science classes have already adopted the two movies as part of their regular courses. Other schools and universities are expected to follow their example. One of the ten-minute films is said to take the place of a laboratory demonstration requiring two hours or more of classroom time—in addition to two or three hours of preparation, always with the worry that some part of the demonstration may go wrong. Small colleges with limited staffs will benefit especially by the innovation, according to Col. F. L. Devereaux, vice-president of the Western Electric Company subsidiary that produced the films and plans their distribution.

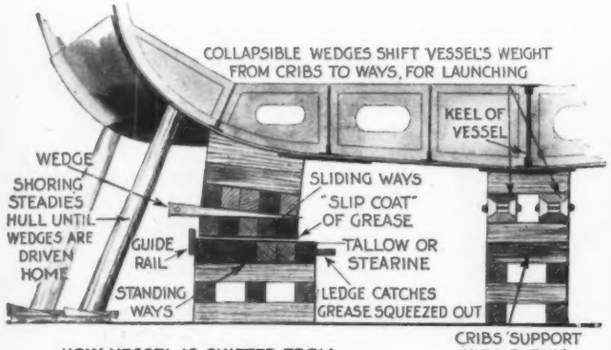
Pictures such as these, their sponsors believe, give an audience an unforgettable insight into the behavior of matter. When the best idea scientists can give us today of what an atom looks like is a "fuzzy ball," a layman can hardly be blamed for understanding only vaguely. The new films visualize how atoms in the aggregate enter into every man's personal life. The way the ninety-two varieties of atoms are grouped into molecules determines whether a substance shall be water, iron, or flesh and blood.

How Biggest Ship

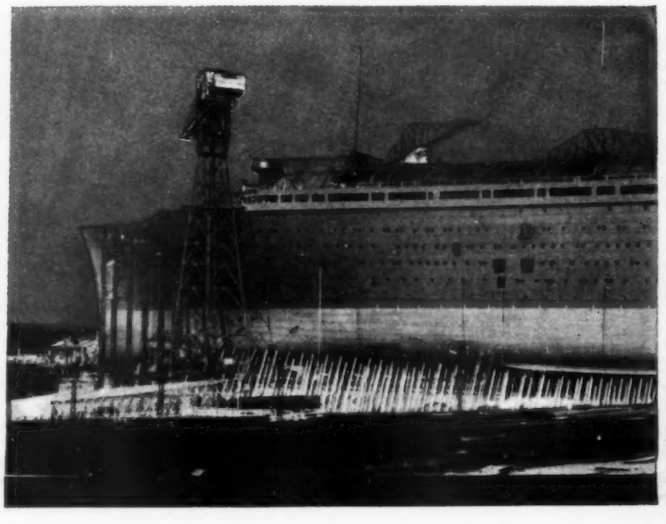
Few Seconds on the Sliding Ways Full of Hazard for New Vessels


HOW TRIGGERS RELEASE SHIP
TRIGGER OPPOSES SLIDING FORCE UNTIL RELEASED
ENTIRE SLIDING FORCE OF VESSEL AND WAYS BEARS UPON TRIGGERS AT EACH SIDE OF SHIP
SLIDING WAYS
STANDING WAYS
HYDRAULIC RAM HOLDS TRIGGER WITH PRESSURE OF 2,100 POUNDS PER SQ. INCH
PORT TRIGGER
TEMPORARY STEEL BRACKETS, RIVETED TO HULL, REST UPON CRADLE
"POPPETS" (CRADLES) SUPPORT BOW AND STERN OF VESSEL DURING LAUNCHING
SPONSOR CHRISTENS SHIP AS IT STARTS DOWN WAYS
STARTING SIGNAL FOR LAUNCHING IS GIVEN FROM PLATFORM
HEAVY STEEL CABLES PREVENT BASE OF CRADLE FROM SPREADING UNDER WEIGHT OF SHIP
WEDGES, DRIVEN IN JUST BEFORE LAUNCHING, TAKE UP CLEARANCE BETWEEN WAYS AND HULL. WEIGHT OF VESSEL IS THEN SHIFTED TO SLIDING WAYS BY REMOVING CRIBBING UNDER HULL (SEE DIAGRAM AT BOTTOM OF PAGE)
WORKMAN OPENS VALVE TO RELEASE TRIGGERS AND START SHIP DOWN THE WAYS
8,000-POUND CONCRETE BLOCKS, CHAINED TOGETHER 20 FEET APART, REST IN MUD UNDER WATER
GUIDE RAIL FOR SLIDING WAYS
SLIDING WAYS
HYDRAULIC JACKS GIVE PUSH, IF NEEDED, TO START SHIP DOWN WAYS
STANDING WAYS
ONE METHOD OF ARRESTING MOTION OF VESSEL AFTER IT LEAVES WAYS
LAUNCHING WAYS FOR LARGE VESSELS HAVE BOWED PROFILE, ASSURING A SLOW START AND RAPID CLEARANCE FOR SAFETY
ARROWS SHOW WHERE FORCES ACT ON HULL AT MOMENT OF LAUNCHING
SLOPE OF WAYS VARIES FROM ½ TO ¾ INCH PER FOOT, THE SMALLER THE VESSEL, THE STEEPER THE SLOPE
BUOYANCY OF HULL LIFTS STERN AND THROWS ADDED WEIGHT ON BOW CRADLE ACTING AS PIVOT
BOW IS STRUCTURALLY BETTER ABLE THAN STERN TO WITHSTAND STRAIN OF PIVOTING AS HULL LEVELS ITSELF, AND IS ALSO DEVOID OF PROPELLER SHAFTS THAT MIGHT FOUL CRADLE

WHY SHIPS ARE LAUNCHED BACKWARDS


COLLAPSIBLE WEDGES SHIFT VESSEL'S WEIGHT FROM CRIBS TO WAYS, FOR LAUNCHING
KEEL OF VESSEL
WEDGE
SHORING STEADIES HULL UNTIL WEDGES ARE DRIVEN HOME
SLIDING WAYS
"SLIP COAT" OF GREASE
TALLOW OR STEARINE
GUIDE RAIL
STANDING WAYS
LEDGE CATCHES GREASE SQUEEZED OUT
CRIBS SUPPORT HULL DURING CONSTRUCTION

HOW VESSEL IS SHIFTED FROM CONSTRUCTION CRIBS TO SLIDING WAYS



ALL READY to take the initial plunge. The 1,027-foot hull of the *Normandie*, the biggest liner ever built, is shown at the right just before the oak wedges transferred it to the sliding ways preparatory to starting it for the sea

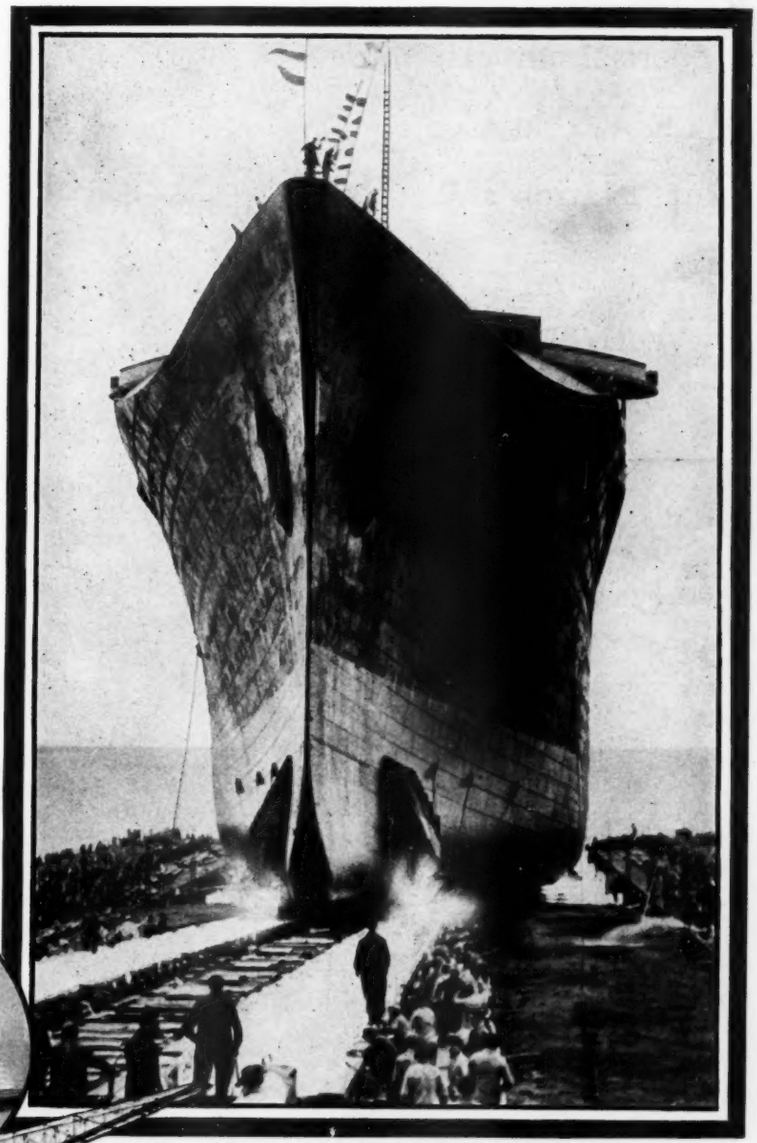
Was Safely Launched

BY SETTING afloat the 75,000-ton *Normandie*—almost a fifth of a mile long and the largest liner ever built—at St. Nazaire, France, a few weeks ago, shipbuilders enacted on record-breaking scale a drama that is repeated every time a new merchantman goes down to the sea.

Planning the launching way is the first step in building a vessel. A double track of wood, leading to the water's edge and extending a short distance beneath the surface—called the "standing ways"—serves as a runway for a pair of cradles known with their platforms as "sliding ways." These support the vessel's bow and stern during launching.

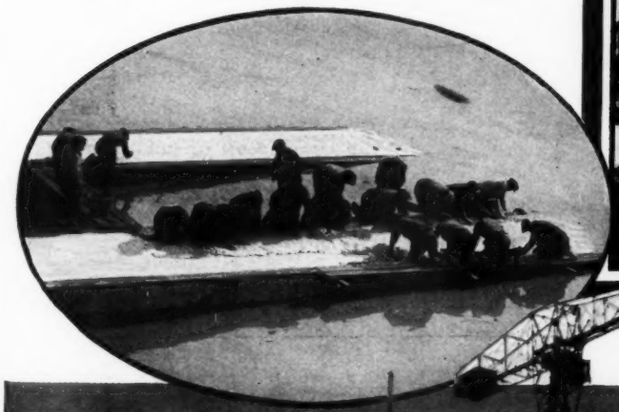
During construction, the ship has rested on temporary cribs. On the day of the launching, workmen transfer it to the ways. Oak wedges are first driven into the sliding platforms. This does *not* lift the hull bodily to the ways—a common popular error—but simply takes up all slack between sliding ways and hull. When temporary cribs and shoring are now removed, the vessel's entire weight settles downward upon the ways, which have been lubricated copiously with tallow and grease.

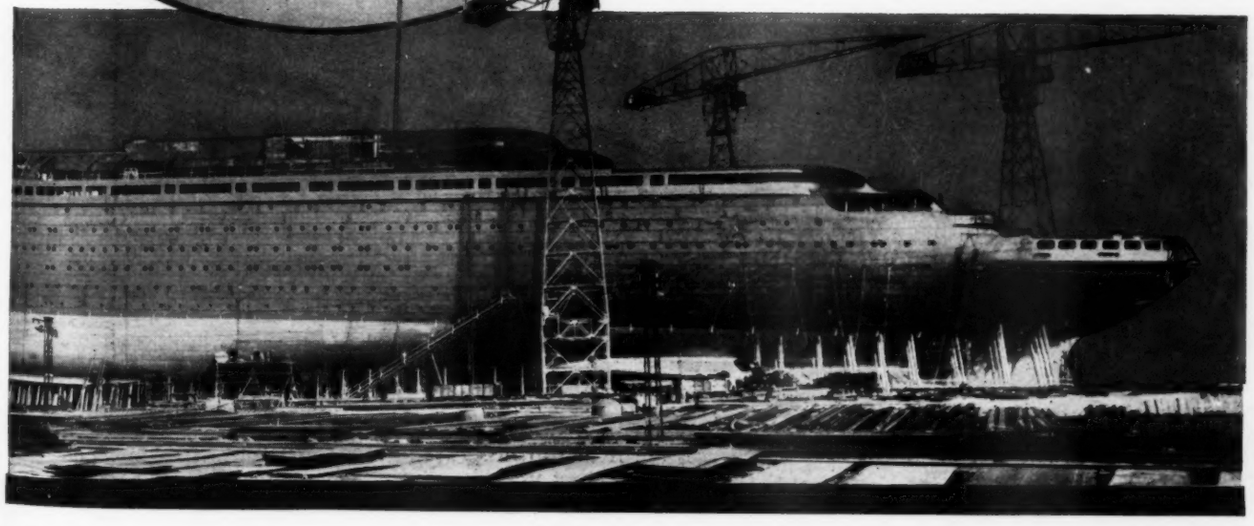
Hydraulic triggers or other apparatus hold the sliding ways until a signal shows all is ready. Then the triggers are released and the vessel slides down to the sea at a speed of nine to twelve miles an hour—a brisk running gait. To minimize the crushing weight on the launching ways, heavy machinery and fittings, including the massive engines, are not installed until after the vessel is safely afloat.



The *Normandie* is on its way down the world's biggest shoot-the-chutes. Note smoke caused by friction as the hull moves

Below, workmen are applying forty tons of tallow lubricant to the ways to make the ship move smoothly

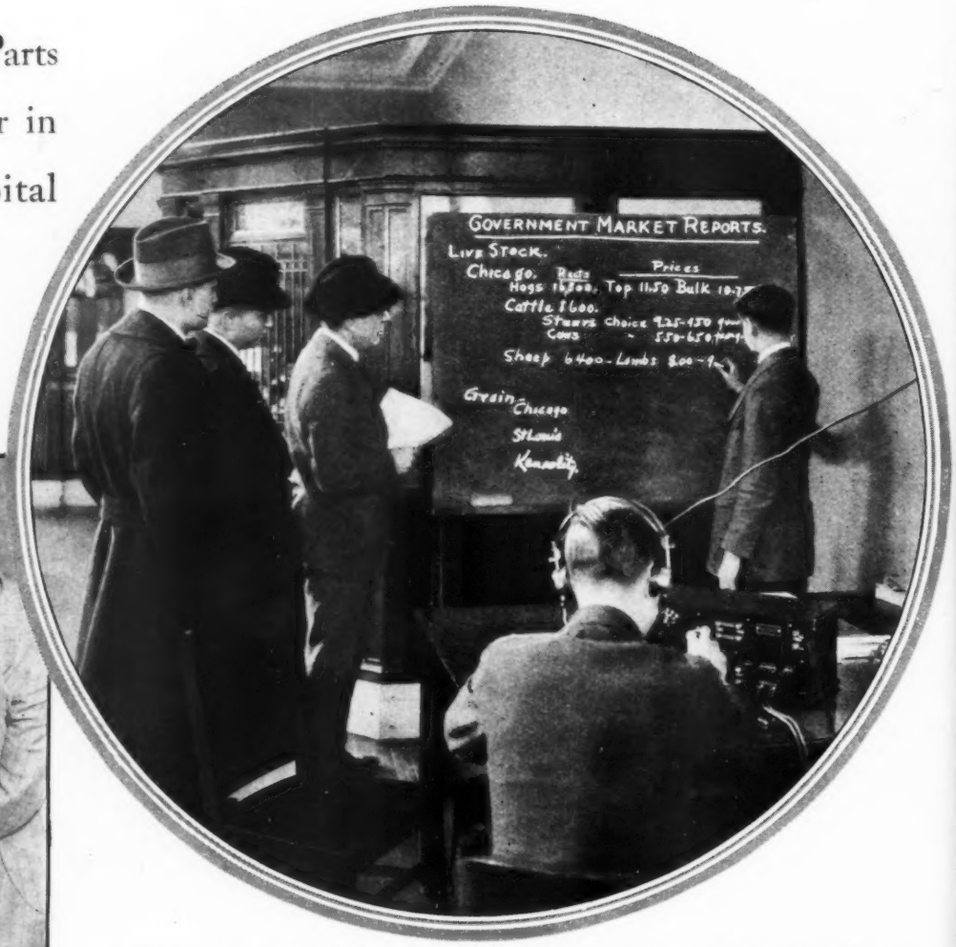




UNCLE SAM'S SECRET AGENTS Save Farmers

Reports from All Parts of the World Center in Our Nation's Capital

By WALTER E. BURTON



Above, posting on a bulletin board in a country bank the Secretary of Agriculture's crop report to protect the farmers against grain sharks. At left, crop experts in the Department of Agriculture need two keys to unlock the box in which crop reports are kept

A DEVASTATING drought visits a part of Southern Russia, injuring wheat and other farm crops, while winds and floods inflict further damage in other sections. From still another area comes the news that wheat rust is causing more damage than the sanguine growers had anticipated.

Not long afterwards, a farmer in Kansas tilts his chair back against the wall, lights his battered pipe, and listens while the voice from his radio tells him that the Russian wheat crop will not be as large as expected, and that American wheat, as a result of this, may find a little better market than he had thought possible.

Between these two incidents is a picture that, for speed, mystery, and excitement, rivals the gathering of news about a world-shocking murder or kidnaping. It is the picture of Uncle Sam, star reporter and operator of the largest and fastest farm news-gathering organization in the world.

Activities of the crop and livestock reporting service of the Bureau of Agricultural Economics, U. S. Department of Agriculture, daily influence you and everyone else in the nation, for they affect the prices that you pay for bread, cotton shirts and dresses, beefsteak, wool suits, and other necessities.

Crop and livestock reporting was developed to its present state of efficiency chiefly as a result of the demands of farmers and farm trade agencies for information concerning crop conditions, especially just before market time. If a grower of corn knows, early in the season, just how much will be produced in the United States and other countries, he has a fairly accurate idea of the prices he is likely to get for his products. If he were kept in the dark about the corn situation in general, a crafty buyer might cheat him by making him believe that there was an oversupply of corn, and therefore that low prices prevailed.

Like a giant spiderweb, the communication lines of the crop and livestock reporting service reach to all parts of the earth where information of interest to American producers is to be found. Foreign outposts of the system are situated in London, Berlin, Belgrade, Marseilles, Shanghai, Buenos Aires, Pretoria, (Union of South Africa), and Sydney. In each of these branch offices are from two to six trained crop experts who collect valuable information and relay it to Washington by the quickest means at their command.

But the most extensive news-gathering system blankets the United States. The headquarters office is, of course, at Washington—in a brand new building of the Department of Agriculture. There are field offices, telegraph stations, and field agents at important points. These perform the double duty of gathering information and distributing reports and summaries from headquarters and other sources.

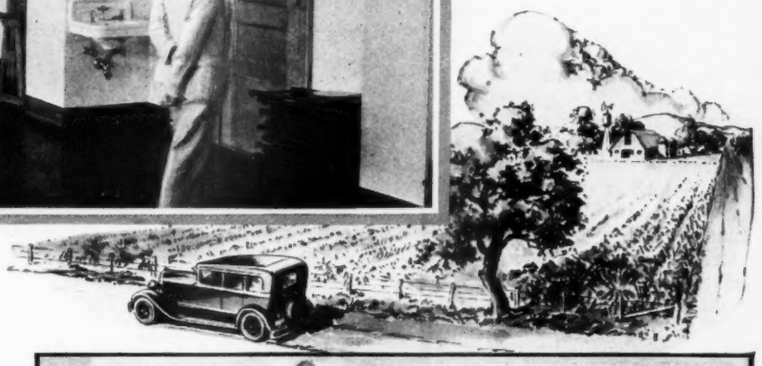
Speed is of first importance in the matter of farm facts that will affect market conditions and prices; so the government maintains a leased-wire telegraph network as complete as that of many other news-gathering services. It is the only government-operated system of its kind. There are about fifty-six offices connected by nearly 11,000 miles of lines, and requiring the services of seventy-five to eighty telegraph operators. In addition, there are several hundred miles covered by telephone and by radio telegraph service.

Information collected and redistributed is obtained largely from farmers. More than 300,000 farmers turn in reports of their crop acreage, livestock production, and the like. Each state office has on its

from CROP SHARKS

CROP REPORTS RELEASED AT THREE O'CLOCK

At left, room in the Department of Agriculture from which crop reports are sent out simultaneously to all parts of the country. Chief telegraph operator stands in front of the clock and will give the signal at exactly three o'clock. Chairman of Board holds copies for the newspapers

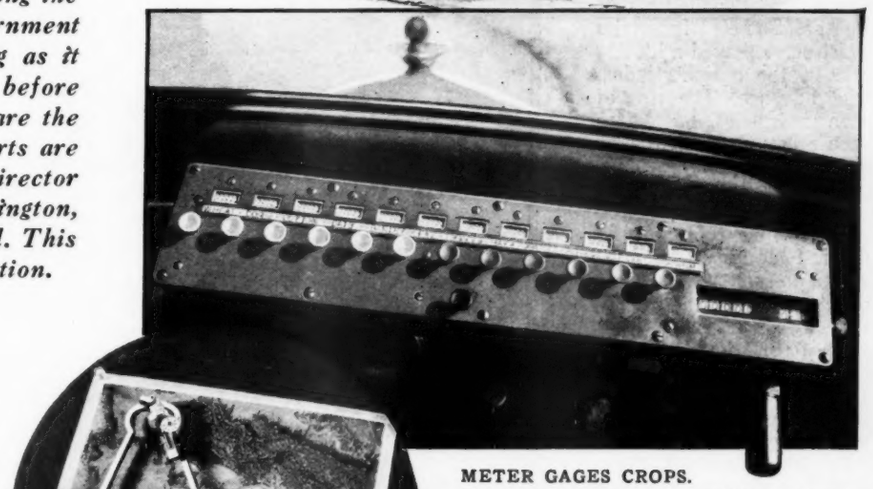


STARTLING was the report given the readers of this magazine recently (P. S. M. Nov. '32, p. 27) concerning the manner in which the American government guards its crop reports. Interesting as it was, that article really put the cart before the horse. How, in the first place, are the data gathered from which the reports are compiled? Mr. Burton asked the Director of Economic Information, at Washington, just how the information is secured. This article is the answer to that question.

staff a man trained in gathering agricultural information, and one or more assistants. These men keep in touch with farmers, and make personal surveys and observations of crop conditions.

Not all farmers look with favor on the activities of government observers. For some reason or other, many think that the government reports cause damage by placing valuable information in the hands of speculators. On the other hand, speculative interests have been even more active than farmers in opposing crop reports. Large concerns which purchase farm products maintain their own observers. It is apparent that if the farmer, who cannot afford to collect his own information, were without government reports, he would be at the mercy of speculators who could persuade him to sell at low prices at times when small crops really created high-price conditions.

The gathering of farm facts goes merrily on year after year. Several ingenious mechanical helpers are used for a portion of the crop estimating. One is a crop meter attached to the dashboard of an automobile which is driven along roads adjoining cultivated fields. The meter is operated by a speedometer mechanism.



METER GAGES CROPS.

This device, above, fixed to dashboard of car is used by agents to help them estimate the acreage that has been planted. At left, an air picture that is used in measuring America's crop area in an effort to verify the data received

Buttons are pressed to record the footage of corn, wheat or other crop.

For example, crop meter measurements have been made in several cotton-growing states for providing a check on acreage changes. Meter-equipped automobiles are driven over the same routes each year, and the road front footage of crops measured. Variations in this footage from year to year give an approximate indication of variations in the number of acres planted. From 2,000 to 5,000 miles of routes are covered in this way in each cotton state.

Another way of checking crop acreage is by watching fertilizer sales. In cotton states where fertilizer is bagged, records are provided by tags attached by the state fertilizer control officials.

Of the various methods used in collecting facts, no one way is absolutely certain; but by checking one against the other, the crop experts can arrive at a fairly definite estimate of conditions.

Such information, no matter how obtained, immediately becomes more valuable than gold—if gold can be compared with acreage figures. If you think that the army or navy represents the last word in secrecy where *(Continued on page 96)*

New Products Hasten Return *of* PROSPERITY

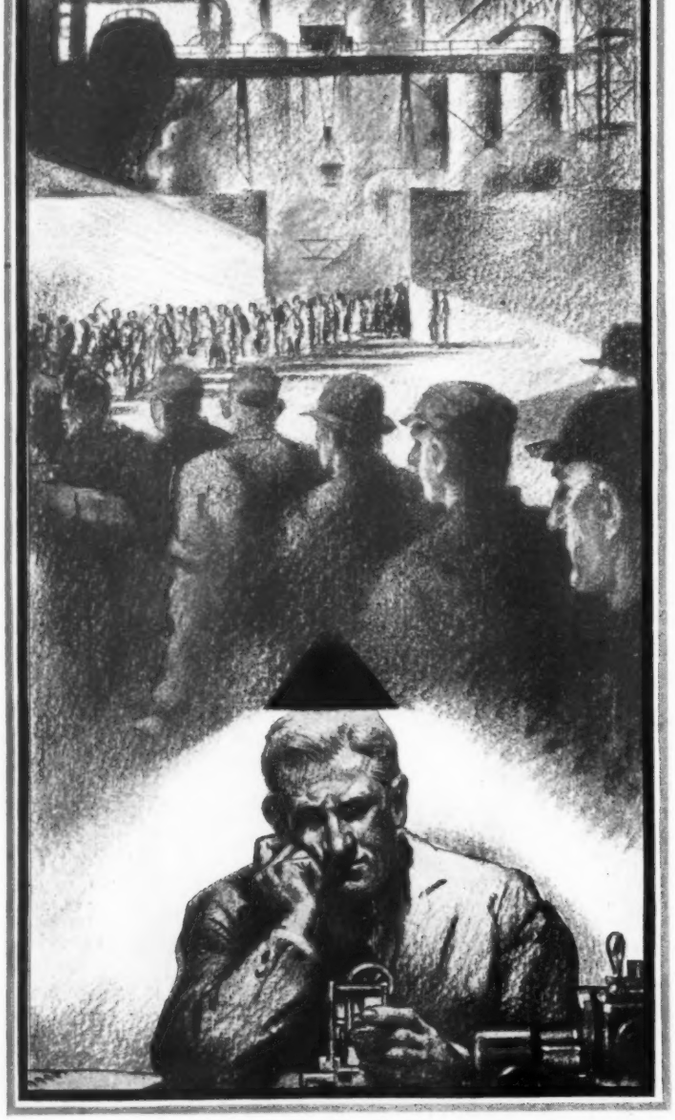
How Inventors' Activity Is Swelling the Growing Tide of Business

MANY times has the statement been made that prosperity will return through the appearance of a great new invention which will create a new industry, just as the development of the automobile, the movies, the radio, has added billions to the national wealth of the United States in the past.

During the last half century, American prosperity has grown by leaps and bounds as the result of American inventive genius. The telephone, the phonograph, the cash register, the airplane, the safety razor, have literally created out of air great new industries which have played a leading rôle in the nation's industrial advance. The rise of such industries has often been a key factor in the return of prosperity after a period of depression.

A careful study of present-day inventive and industrial activity, however, shows no such revolutionary development on the horizon. No single invention appears likely to bring an end to this depression. Instead, the next few years will see the return of prosperity through the appearance of thousands of new and improved items, each contributing to the total volume of augmented business.

A comprehensive survey, just completed by POPULAR SCIENCE MONTHLY, shows this beyond a doubt. Covering thousands of manufacturers and all parts of the country, it reveals that an overwhelming percentage of the concerns are placing new and improved products on the market. The data show manufacturers have done more to improve their products in the last two years than in the whole decade from 1920 to 1930. It shows that more new products have been devised and more neglected inventions have been put on a basis of actual production during these two years than at any similar period in all history. Out of this practical action and pioneering spirit throughout America will come a new era of progress and prosperity.



PREPARING FOR THE RETURN OF PROSPERITY. Yankee ingenuity and progressive manufacturers are laying the foundation for the return of prosperity. Each new product plays its part in increasing the volume of business and in bringing success to everyone

Prosperity depends upon the circulation of money. And, this circulation is most quickly increased by the introduction of new products so attractive and valuable the public is compelled to buy them.

The typewriter is a case in point. A bottle of ink and a pen costs, at most, fifteen cents. A typewriter costs twenty-five dollars or more. Yet, the typewriter turns out written words so much more rapidly and efficiently that millions of people have been willing to pay the extra cost to obtain the benefits of the new product.

Similarly, a host of other new items have shown definite improvement over existing equipment and have found a ready market. By creating a flood of new and better products, manufacturers will stimulate a tremendous demand from the buying public.

That this is being realized, is indicated from all sides.

The number of new items being submitted for inclusion in the editorial pages of POPULAR SCIENCE MONTHLY has never been so great as in recent months. In the middle west, a New Products Conference recently attracted representatives from industries all over the nation. The problems of creating, perfecting, and marketing new products were discussed by experts. When an eastern technical school, a few weeks ago, invited manufacturers to send exhibits for display during a New Products Day, the response was overwhelming.

A leading New York patent attorney told a representative of POPULAR SCIENCE MONTHLY that never in forty years of practice has he seen so many inventors occupied in perfecting small, useful devices as at present. The demand of manufacturers is for items of novelty and utility which will have high value and find a ready market.

The head of an eastern advertising agency declares that his clients have shown more interest in new products during the last six months than at any other time in twenty years. The research engineer in charge of a famous industrial laboratory reports that experiments concerned with the far-distant

Illustrations by
FRANK HUBBARD

RECORD NUMBER OF AUTO IMPROVEMENTS. There were more changes and improvements in autos and auto equipment during 1931 and 1932 than in the preceding ten years

future are being shelved while the staff of experts under his direction concentrates upon improvements and innovations which can be placed upon the market at once.

An association of more than 800 manufacturers recently made a survey of its members to see what steps they were taking for a return of prosperity. The number who were turning to new products ranged in the various classifications of the industries, from fifty to ninety percent of the concerns.

Other trade groups tell the same story. When interviewed recently, the secretary of one national association of manufacturers concerned with home equipment, said:

"It is safe to say that our members are marketing four times as many new products now as they were in 1928."

The statistician of another home product manufacturer's association reported:

"There have been more new and improved appliances in our field during the past two years than made their appearance in the dozen years that went before."

And the head of a national group of motor car manufacturers declared:

"There have been more innovations, changes, and improvements in automobiles and automobile equipment during 1931 and 1932 than there were in the whole decade which preceded those years."

An organization which specializes in introducing new products into department and chain stores has made a special check upon the number of such products appearing in different years. It has 1,500 stores in the United States and Canada as its clients. The result of its check shows that the last six months have seen the greatest flood of small, ingenious, new items issuing from American factories that the concern has ever experienced in its entire history of marketing such new products.

Another company in the middle west makes a business of placing new inventions with manufacturers looking for new products in their particular fields. Recently, 336 inquiries were received from such manufacturers concerning items which appeared in a single bulletin sent out by the organization. This record number of requests for more information, indicates the keen interest and increased activity among companies in connection with new and improved products.

"Any company," a noted industrialist told several hundred manufacturers at a convention not long ago, "which does not keep up its product development is riding for a fall."

Industry is awake to the fact that it is the new, the novel, the improved product that will sell today. The following is quoted from the official publication of the leading trade association in the United States:

"Industry may have slowed down its production, business its pace. But there is no slackening of interest among business men in new and useful products and processes.

"Despite the depression, the flow of new products and processes in industry continues unabated. To them, many established companies are turning in an effort to put idle plant capacity to use."

How necessity has proved the mother of invention and the manner in which depressions have increased the number of patents applied for in the past is shown by a glance at the records.

The Silver Campaign Depression of 1895-7 showed a marked increase in the number of patent applications received. Similarly, the Rich Man's Panic of 1903-4 showed the largest number of applications ever received up to that time. Again, the Panic of 1907 brought in the largest number of applications up to that year and the depression of 1911 showed a jump of 5,000 applications as a result of business stagnation. But, most striking of all, was the increase which came as a result of the Primary Post War Depression which occurred in 1921 and 1922.

However, the number of new ideas finding their way from the workshop and laboratory to actual production in factories and sale in stores is greater during the present months than during any previous period of depression.

Yankee ingenuity and progressive manufacturers are laying the foundation for the return of prosperity.

A glance at the patent records of the world gives an interesting sidelight upon the relation of improved products and prosperity. It is not just a happen-so that in the United States, where wealth has increased most rapidly, innovators have been most active. From the beginning of the patent records in each country to the end of 1930, the totals in the four leading nations are: 825,882 for France, 754,054 for England, 531,681 for Germany and 1,797,380 for the United States. The seventy foreign nations which issue patents have a grand total of 4,395,493. Thus, busy American inventors, alone, hold more than one-fourth of all the patents in the world.

With more than 100,000 American manufacturers alert for new ideas and watching for improved products which they can add to their lines, the tide of newly-marketed items is steadily rising. Each new product, with greater eye or utility appeal, plays its part in increasing the volume of business and in producing prosperity for all.

While the general public watches for some spectacular single invention to pull the country out of the depression, thousands of small, unnoticed, useful innovations are lifting it toward prosperity.

FLOOD OF NEW PRODUCTS. During the last six months, the greatest flood of small, ingenious new items has issued from American factories that was ever experienced by this country

Car Thieves Stopped by Exploding Shell of Gas or Smoke

Demonstrating a new means of protecting autos from thieves. As the car is started, a cartridge automatically releases either irritating gas or smoke which forces the thief from the wheel

Woe to the car thief who attempts to steal a machine equipped with the latest protective weapon! The moment he starts to drive away, an automatic cartridge discharges a cloud of gas. Overwhelmed by the fumes, the thief is glad to make his escape from the suffocating fumes.

Smoke cartridges may be used instead of gas if desired. They are less perilous to an absent-minded car owner who may forget to detach the anti-theft mechanism when he returns to his parked auto.

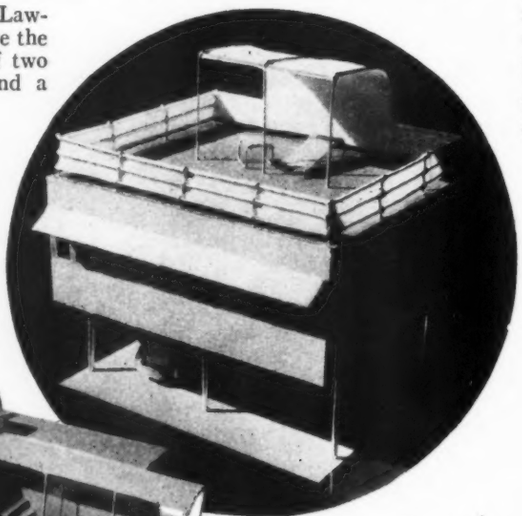
GIGANTIC INSULATOR HAS TRANSFORMER INSIDE

Fourteen feet in height, a porcelain insulator, with a transformer inside it, has been developed for use on a 220,000-volt transmission line in Ohio. The result of this odd arrangement is improved insulation in the circuit where it is employed. In addition to its electrical advantages, the insulator is considered a masterpiece of pottery-making. It is formed in two halves, each having a shell of one-piece porcelain. The photograph shows the comparative size of the huge insulator.

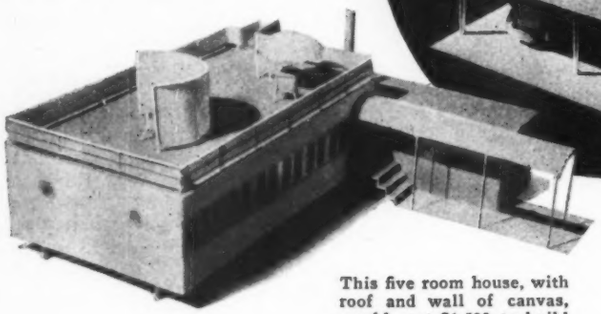
Fourteen feet in height, a porcelain insulator has its transformer built inside it

ARCHITECT DESIGNS COTTON HOUSES

Houses of cotton are proposed by Lawrence Kocher, noted architect, to solve the low-cost housing problem. Models of two types, a $1,500 five-room home and a week-end house, have been designed. A weatherproof exterior is provided by a roof and walls of fireproofed cotton ducking stretched over a wooden structural frame. Inner walls are also of cotton. Insulating material may be added to exclude heat and cold. Since the canvas is flexible, it is adaptable to any shaped surface.



A week-end house of cotton designed to be raised eight feet from the ground, having a parking space and playground beneath it



This five room house, with roof and wall of canvas, would cost $1,500 to build

DOGS NOW NOSEPRINTED TO PROVE OWNERSHIP

Taking noseprints of dogs to guard them against loss or theft is the method being adopted by western owners. When two persons claim the same dog in court, ink noseprints, like the specimen illustrated, settle the matter. Like human fingerprints, the patterns on the nose of the dog are said not to change with age, and therefore a pet need submit but once to having its nostrils smeared with ink. No two dogs have identical patterns so a mistake is impossible.

ODD INSTRUMENT MEASURES HUMAN EYE

To aid in fitting eyeglasses, an optical expert of St. Paul, Minn., has invented an instrument that measures the exact distance between the pupils and between the pupil and the nose. Most persons' eyes are unevenly spaced, and this must be taken into account in fitting glasses. Through twin tubes, as illustrated, the examiner sights upon the patient's eyes and moves a pair of cross-hairs within the instrument until they center upon the pupils and register the spacing with a high degree of accuracy.

Diving Tube for Treasure Hunters

George Anderson, of Seattle, Wash., inventor of the diving cylinder, is seen entering it through the top. When the cover is closed, the cylinder will be lowered by means of a winch on the barge. Rings inside the cylinder serve as rungs in a ladder in climbing up or down

Arms, light, and window of diving cylinder

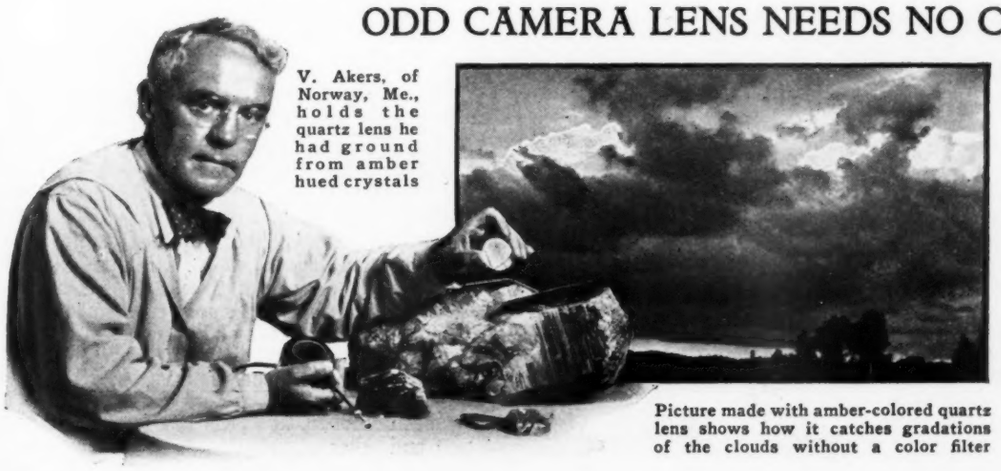
Arms on the end of diving cylinder tied this chain around the pump 100 feet below the ocean's surface

HOLLOW CYLINDER CONTAINS SUFFICIENT AIR FOR A FOUR-HOUR DIVE
SWIVEL FLOODLIGHT CONTROLLED FROM WITHIN CYLINDER
FINGER-LIKE TONGS ATTACH CHAINS TO SUNKEN OBJECTS

Breakaway view showing how diver operates the mechanical arms with levers placed inside tube

To AID in recovering sunken valuables, a marine engineer of Seattle, Wash., has devised a diving cylinder for deep-water use. Within this metal cylinder, he declares, a diver keeps dry and may work comfortably under normal air pressure as far as 400 feet below the surface, a depth far beyond the range of ordinary rubber diving suits. The operator stands at the bottom of the cylinder, which contains sufficient air for a four-hour descent. He is lowered from a barge, with which he is in constant telephone communication. With the aid of an ingenious pair of tongs, resembling fingers and controlled from within, the operator may attach chains to a sunken object so that it may be hauled to the surface. A swivel floodlight, also controlled from within, provides illumination as the operator looks out of the heavy glass porthole. The inventor, George Henderson, says he has successfully tested his device in Lake Washington and in a number of dives off the Washington coast. In one experiment 100 feet below the surface, a chain was successfully looped and knotted around a metal pump by means of the cylinder's mechanical arm.

ODD CAMERA LENS NEEDS NO COLOR FILTER

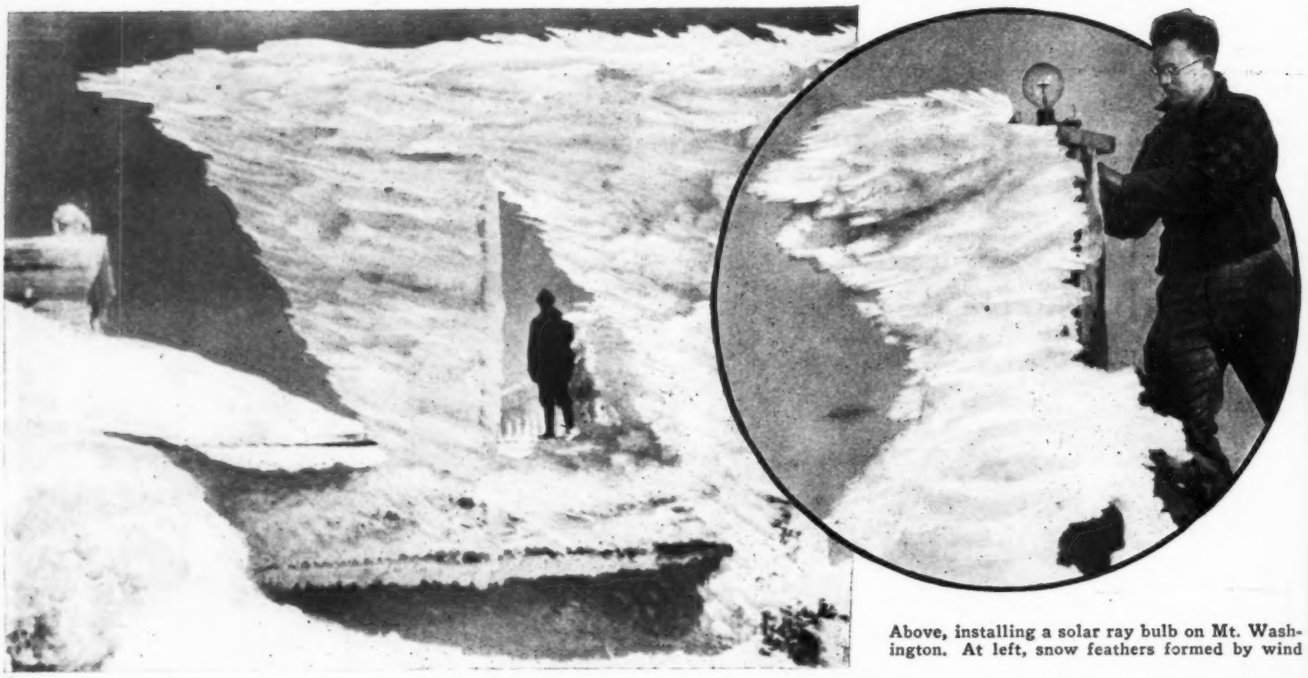


V. Akers, of Norway, Me., holds the quartz lens he had ground from amber hued crystals

Picture made with amber-colored quartz lens shows how it catches gradations of the clouds without a color filter

SEEKING a camera lens that would permit fast exposures with proper color values, V. Akers, landscape artist and photographer of Norway, Me., hit upon a novel material. Crystals of citrine quartz had been found in a mica mine nearby, and Akers obtained a crystal and had it ground into an experimental lens. The experiment succeeded. Because of the yellow tint of the quartz, Akers found he need not use a color filter to hold back blue rays.

Secrets of Frost Feathers Sought on Mountain Top

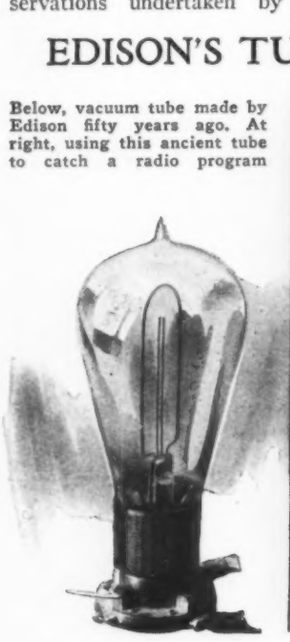


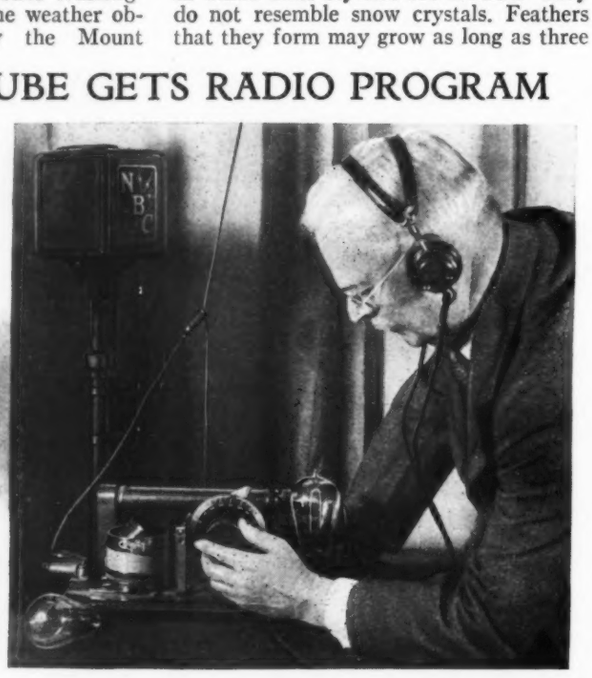
Above, installing a solar ray bulb on Mt. Washington. At left, snow feathers formed by wind

SHOWY frost feathers, that form in glistening spikes on buildings swept by icy winds, have lured a little band of scientists to the frigid summit of Mount Washington, N. H. As a part of the weather observations undertaken by the Mount Washington Observatory, they will attempt to solve the mysteries of the strange formations. Little is known about the way in which frost crystals are formed. They do not resemble snow crystals. Feathers that they form may grow as long as three feet, growing to this size in the space of one cold and windy night. The striking photograph in the circle is of a frost feather formed in this way. Such feathers indicate the direction of the prevailing wind at the point of observation.

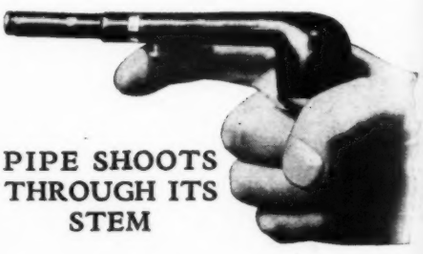
EDISON'S TUBE GETS RADIO PROGRAM

Below, vacuum tube made by Edison fifty years ago. At right, using this ancient tube to catch a radio program





A VACUUM tube was devised by Thomas A. Edison fifty years ago, long before the first crude wireless sets were dreamed of. Proof of its ability to pick up a modern radio program was given the other day at a New York broadcasting studio. Music broadcast from a small transmitter in the studio was tuned in on a receiving set using a faithful copy of Edison's original tube, with a curved filament of carbonized bamboo and a plate formed of two upright wires. The program, received with perfect clarity, was then re-broadcast to radio listeners. At the time of its invention, the tube was regarded merely as a scientific curiosity.



PIPE SHOOTS THROUGH ITS STEM

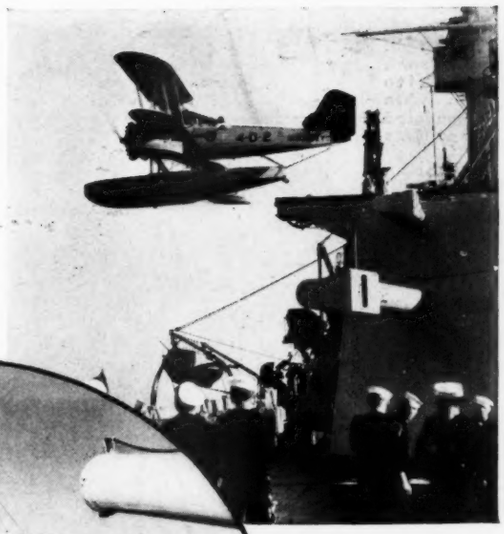
THOUGH innocent enough in outward appearance, a novel type of firearm disguised as a smoking pipe serves as a formidable weapon when it is needed. The gun fires a .25 caliber cartridge. Its stem unscrews for loading, while the bowl of the pipe serves as a magazine for five extra rounds of ammunition. A knurled screw near the center serves as a trigger, and fires the pipe pistol when it is pulled back as illustrated in the photograph above, the user sighting meanwhile along the length of the stem. A German inventor is responsible for the unusual weapon.

HOLDER ENCLOSES CIGARETTE

NO LONGER will sparks from cigarettes menace rugs and clothing if a new safety first cigarette holder of metal pictured at the left, should find favor with smokers. The user inserts a cigarette in the tubular opening, adjusts small metal jaws that hold it, and lights it through an upper slot. A convenient ring slips over the finger for holding the device. Wire screening on the side prevents the escape of sparks. Even the added convenience of an ash tray has been built into the device by the thoughtful inventor. Ashes fall into a removable receptacle at the bottom, as does the cigarette when it has been smoked. It opens readily for removal of butt and ashes.

New Navy Planes Land on Water or Deck

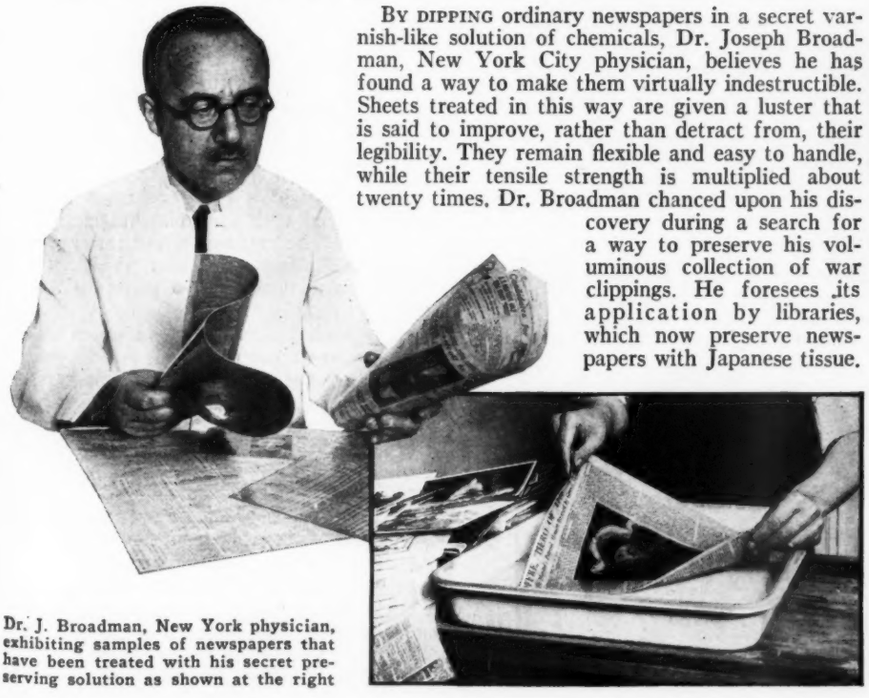
At left, one of the Navy's new amphibian planes is taxiing up to a crane that will hoist it on the ship's deck. In circle, the plane is seen held by the crane that swings it aboard



One of the new planes an instant after it has been hurled into the air by a catapult from the deck of the ship *West Virginia*.

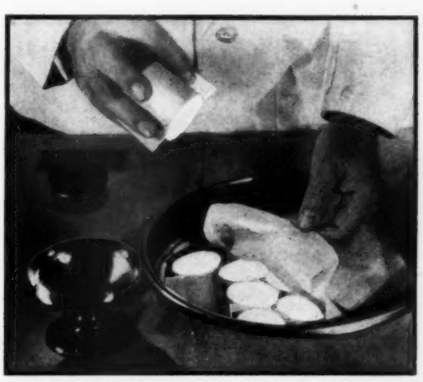
AMPHIBIAN airplanes, able to land either in the water or on the deck of an airplane carrier, are now being used at sea by the United States Navy. The photographs reproduced here were taken during recent naval maneuvers off the California coast. They show the launching and landing of planes attached to the battleship *West Virginia*. Catapults are used to launch the planes. The return of a plane to the ship is a spectacular maneuver. With wheels retracted, the amphibian lands in the sea and taxies up to the ship and stops beneath a jointed crane. The pilot grasps the hook at the end of the hoisting cable, making it fast to the plane which is then swung aboard the vessel. For landing on an aircraft carrier's deck, the wheels are extended beyond the pontoons and the landing is performed in the manner of a land plane, the pontoons being held clear of the ground by the extending wheels.

SECRET PROCESS SAVES NEWSPAPERS



Dr. J. Broadman, New York physician, exhibiting samples of newspapers that have been treated with his secret preserving solution as shown at the right

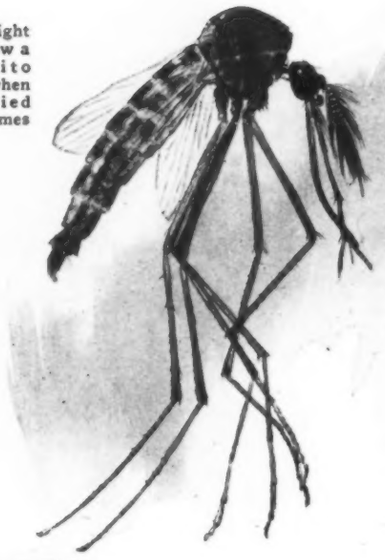
BY DIPPING ordinary newspapers in a secret varnish-like solution of chemicals, Dr. Joseph Broadman, New York City physician, believes he has found a way to make them virtually indestructible. Sheets treated in this way are given a luster that is said to improve, rather than detract from, their legibility. They remain flexible and easy to handle, while their tensile strength is multiplied about twenty times. Dr. Broadman chanced upon his discovery during a search for a way to preserve his voluminous collection of war clippings. He foresees its application by libraries, which now preserve newspapers with Japanese tissue.

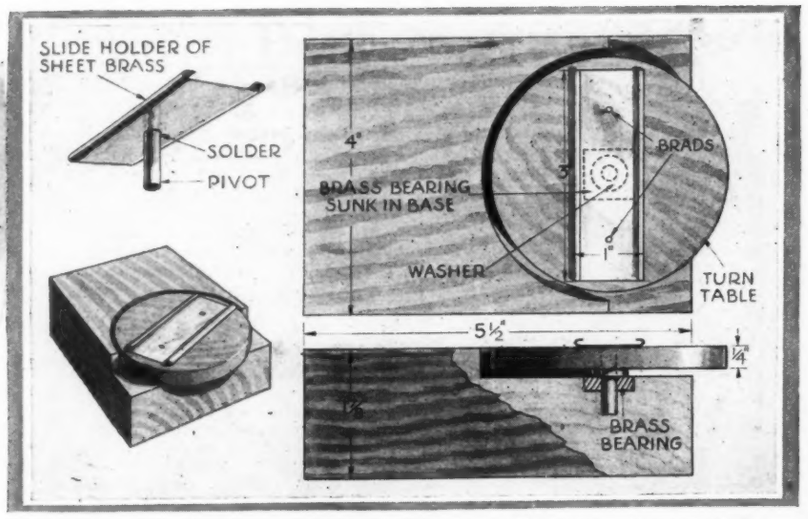


ONE DISH OF ICE CREAM NOW PUT UP IN CARTON

A NEW way of serving ice cream has been perfected by a Louisville, Ky., inventor. The cream is packaged in small, round cartons holding individual-sized portions. Tabs on each wrapper enable it to be removed with one hand, dropping the contents in a dish as shown in the photograph above. Special machinery has been designed for the manufacture of the new-style packages. The frozen cream, first rolled into sticks and covered with waxed paper, is sliced to the proper size to fit the package.

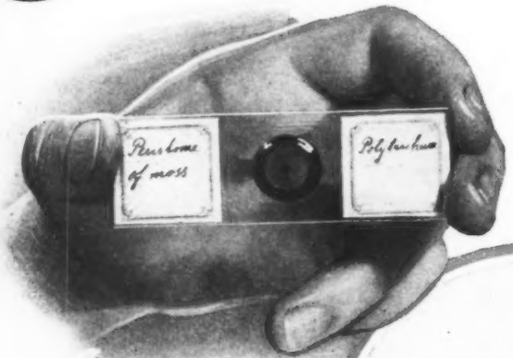
Photo right shows how a mosquito looks when magnified eleven times

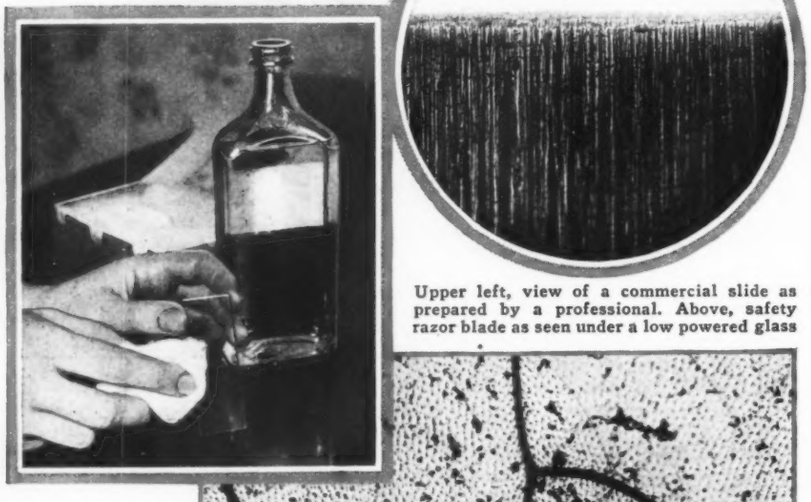




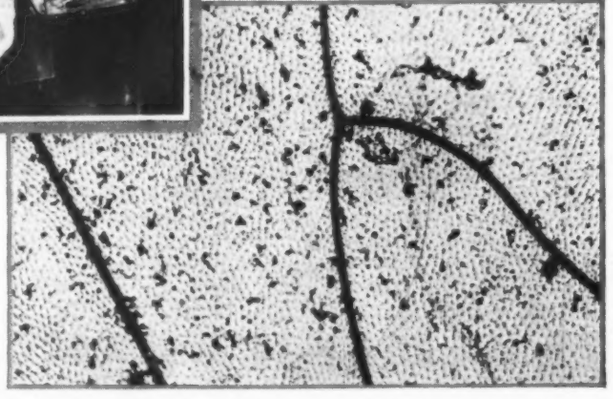
Drawings above show the manner of preparing a turntable for yourself upon which a glass slide is placed so that a low wall of shellac can be built up to inclose specimen

Creating New Worlds *with* YOUR





Upper left, view of a commercial slide as prepared by a professional. Above, safety razor blade as seen under a low powered glass



Above, before a slide is used, it should be cleaned with alcohol as shown. At right, wing of house fly as seen under a microscope. Dots are dust particles

PRACTICALLY boundless and much of it still awaiting the curious eyes of those who would unravel nature's secrets, lies the world you can see only with a microscope.

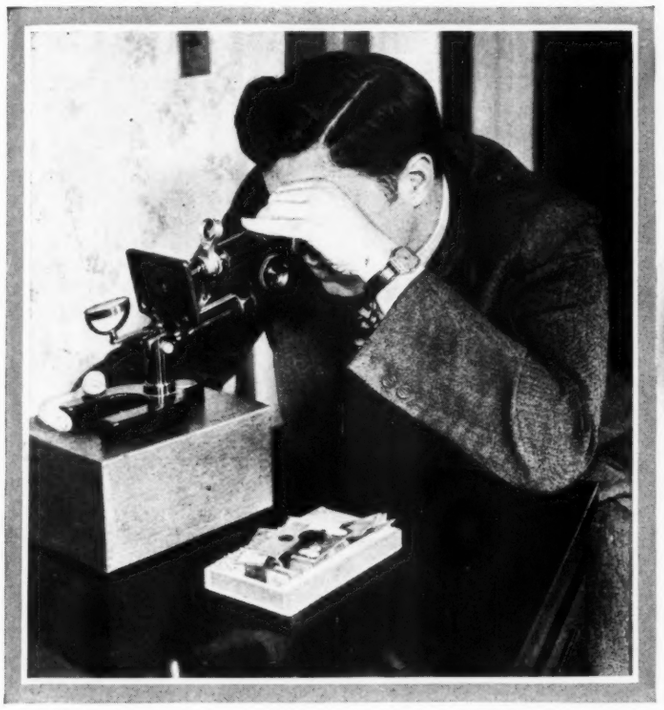
Within his borderless domain, the microscopist can populate little worlds of his own making. From a scene almost as still as death, he can create a world teeming with life. He can bring into being countless millions of tiny creatures not visible to the naked eye.

One way to do this is by what is known as a hay infusion. A few stems of hay are placed in a jar of tepid water and permitted to stand undisturbed in a warm room for about four days. Then some of the water is taken off with a spoon or a medicine dropper and a drop of it is placed upon a slide freshly cleaned with alcohol. When this is done, we shall be amazed to find many weird creatures streaking across our vision. The scene is like a nightmare—a phantom world peopled by strange creatures.

Just as we have brought this strange world into being, so we can destroy it and its queer inhabitants. Before we commit this master crime, however, we shall need more equipment. It will serve not only for this amazing experiment but will prove useful in many others, so the time used in making it will be well spent.

When specimens are mounted permanently, they are placed between the microscope slide and a thin, button-like cover glass. These transparent covers are fastened to the surface of the slide by a special preparation applied in a circle with a camel's hair brush in the manner to be described.

To do this quickly and easily, we will need



By Borden Hall

Specimens, sealed beneath cover glass on a slide, can be preserved as part of your collection

Left, picture shows how an examination of a specimen can be made with the microscope tilted. Above, view of a plant louse magnified 12 times

This photo shows manner of adjusting the shutter under the stage of the microscope

MICROSCOPE

a turntable similar to the one shown in the sketches. The base is a piece of trimmed "two by four" recessed to accommodate the turntable proper. The recessing may be done with a sharp knife. Of course, the base also may be made from two pieces screwed together, the toppiece being cut out with a band saw or a coping saw. The solid form of construction, however, is best if the maker has the patience.

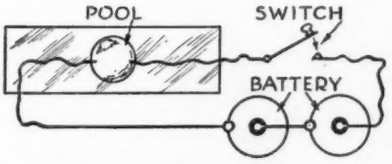
A piece of heavy sheet brass, bent to the dimensions shown, serves to hold the specimen slide and the worker should see to it that the slide will slip in and out easily. A small shaft of brass or iron, (a piece of a large nail or spike will do), soldered to the bottom of the rack forms a pivot. The bearing for this member can be made from a piece of brass drilled to produce a snug fit for a shaft.

The turntable is cut from a well-seasoned piece of quarter-inch wood drilled to receive the shaft, the slide holder being fastened to the turntable with two small brads. When a small washer with a drop or two of oil is placed between the turntable and the base and a coat of shellac is applied to the entire instrument, it is ready for use.

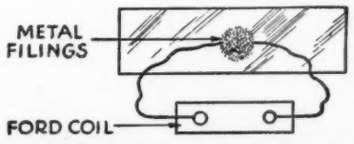
When a slide is placed in the holder and a brush dipped in shellac or other preparation is held near the center of the slide, which is revolved by bringing one finger in contact with the free edge of the turntable, a circle of shellac will be drawn on the glass. By permitting the first coat to dry slightly and adding other coats, a low wall of shellac may be built up to enclose your specimens.

For the wholesale murder we contemplate, we shall need several applications of shellac so that the wall will be high enough to retain several drops of water. The water is taken from the bottle containing the hay and it teems with infusoria.

We murder by electrocution and the drawing on this page makes the method clear. Only two dry cells will be needed with two tiny copper wire terminals immersed in the solution. After the water is placed in the well and the wires are arranged, we focus the microscope and then watch for an opportunity. When the scene looks right and the proper number of hay water denizens are in sight, we throw the switch. Presto! Death stalks the scene with lightning-like rapidity. What had looked like a crowd of people at a country fair is now a scene of utter



How connections are made to kill specimens wholesale so they can be preserved



With this apparatus sparks are made in iron filings and rare displays produced

desolation. We now can study the motionless specks to our heart's desire.

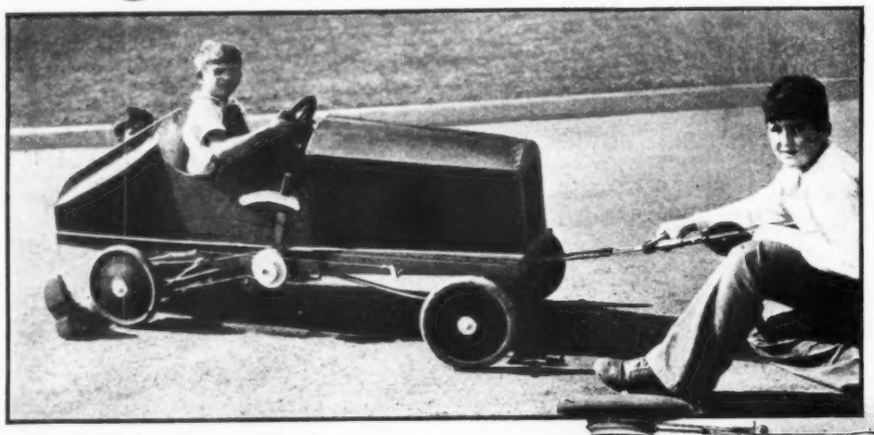
Now, let us leave the realm of biology and follow the by-roads of physics. For the next experiment, we shall need an old Ford spark coil, obtainable for almost nothing from the junk heaps of auto wrecking yards, three dry cells, a microscope slide, and some iron or copper filings. These materials are arranged on the stage of the microscope as illustrated.

After the instrument has been focused, the primary circuit of the coil is closed and a spark is permitted to play among the filings. Instantly we are treated to a sight that will long be remembered. Here we see a display of fireworks that will appall us and if the wires are rearranged in various positions, different effects may be obtained.

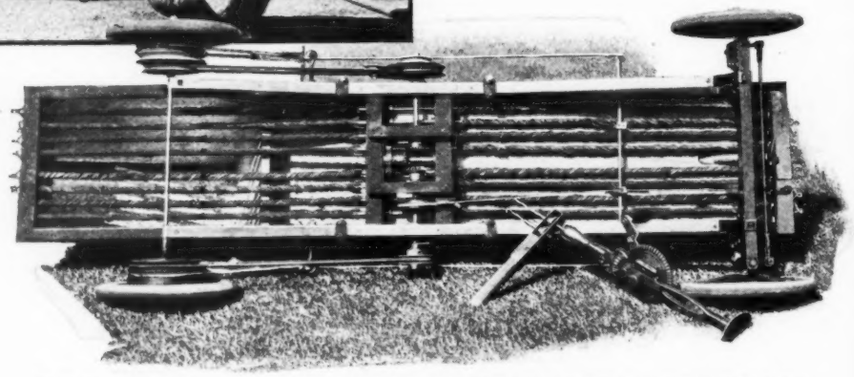
Mounting specimens for study is in itself a fascinating task. Perhaps the best object for the beginner is a fly's wing, since it is transparent. Indeed, we may start our work by preparing an interesting collection of different transparent wings—wings from a bee, a mosquito, a wasp, a yellow jacket, a fruit fly, and other common insects.

Specimens must be mounted *absolutely* dry. This does not mean that they should be placed in an oven for a few minutes; the preparation is much more elaborate than that. For *(Continued on page 82)*

Midget Automobile Has Rubber Band "Motor"



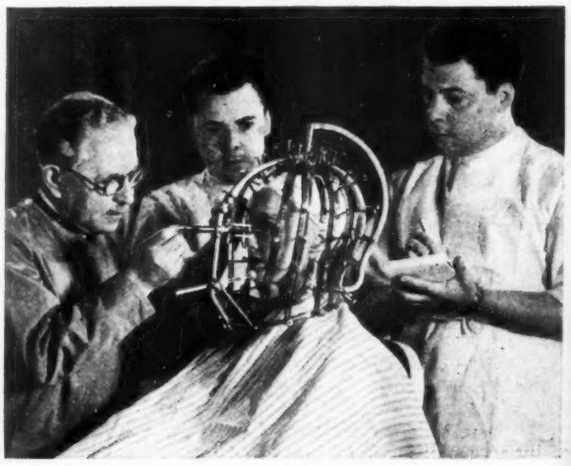
GANGWAY for an automobile that has no engine, uses neither gas power nor man power and yet runs. The secret of the unusual machine, recently seen on the streets of Los Angeles, Calif., is a set of sixteen powerful rubber bands. These are twisted exactly as bands are twisted to propel a model airplane. So much force is stored up in them that they will run the baby car for two miles on one winding. The pull of the bands is led through gears to a cross shaft fitted with grooved pulleys whence the power is carried by two leather belts to the rear wheels. One belt drives the car ahead. The other is for reverse.



Above, the motorless automobile ready for a spin. At right, rubber bands that run it and the drill with which they are twisted to give them power

MACHINE MEASURES BEAUTY OF FACE

EVEN beauty may now be reduced to cold, hard figures, according to the inventors of a device that is said to record the contours of a face with thousandth-of-an-inch accuracy. Beauty shops might use the device, the inventors say, to learn how to change their customers' features. In the inventors' opinion, the following measurements are ideal: *nose*, same length as the height of forehead; *eyes*, separated by a space the width of one eye.



10,000 DISHPANS LIGHT WORK AT HOOVER DAM

BUILDING a dam with the aid of light reflected from 10,000 dishpans is the unusual engineering feat now being carried on at the site of Hoover Dam, near Boulder City, Colo. Reflectors were needed for the powerful lights strung up in Black Canyon. Many kinds were tried and at last it was found that dishpans answered the purpose, at low cost, better than anything else. The picture shows two of these strange reflectors in use.

SKID CHAINS FOR SHOES

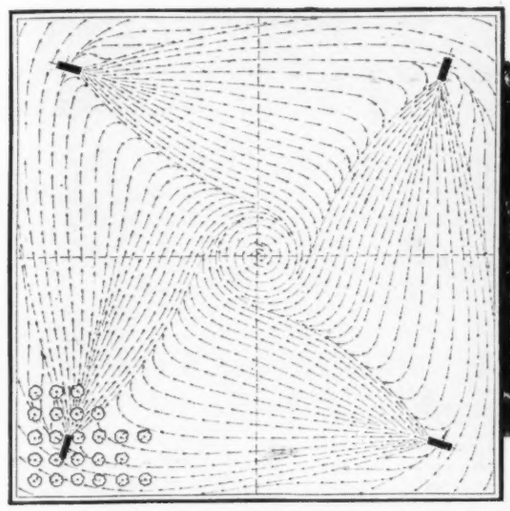
PEDESTRIANS need no longer slip and slide on icy sidewalks, according to Bert Noblette, Winchester, Ky., inventor of the skid chain for shoes shown in picture at the right. The chains cut into the ice to prevent slipping and thus make walking safe and comparatively easy.

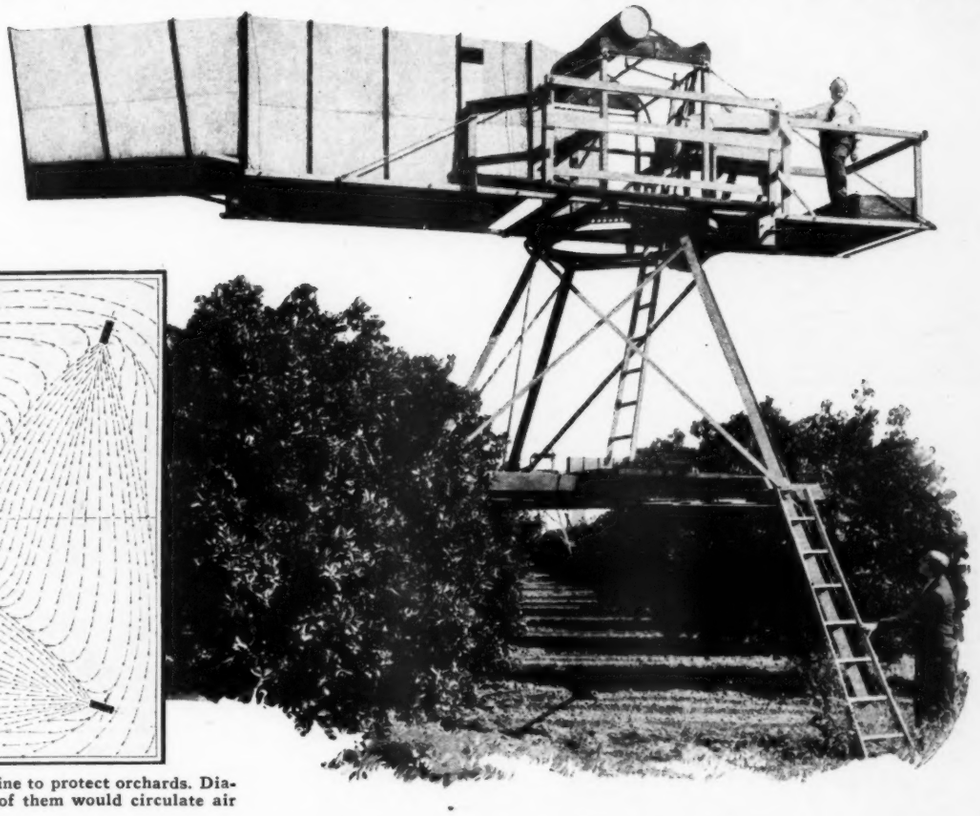
HIS XYLOPHONE SELLS PASTRY

WHEN the housewives in Los Angeles, Calif., hear the notes of a xylophone, they know their traveling baker is at hand. This salesman built, and attached to the door of his car, a five tube xylophone of one-and-one-half inch brass pipes. Striking these with a small hammer he beats out a tune, thus announcing his presence and saving himself the trouble of getting out of his car.

Giant Defroster Guards Fruit Trees

Group of Powered Fans Drive Warm Air Into Orchard





At right, newest type of machine to protect orchards. Diagram above shows how four of them would circulate air

WILL roaring breezes from airplane propellers save California's citrus groves and Oregon's cranberry bogs from frost-bite? Grotesque blowers resembling airplane fuselages on stilts, are being widely installed, following successful experiments last year, to combat the costly frosts of late spring and early fall.

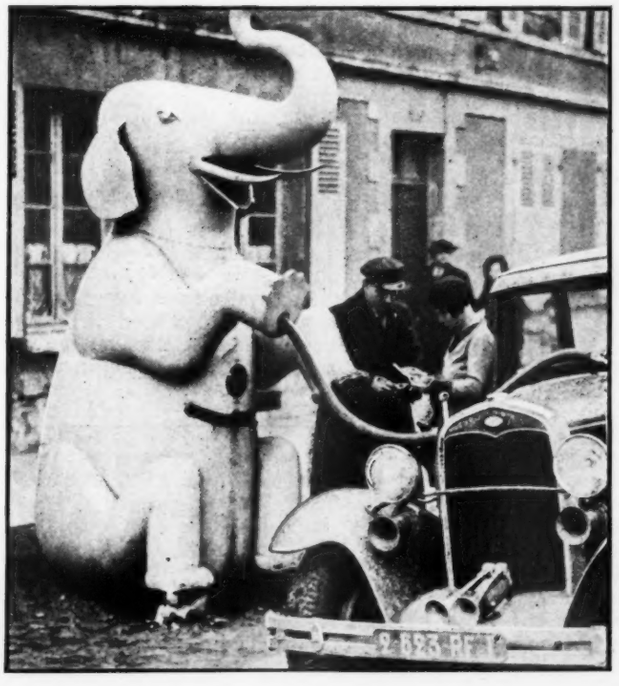
Whenever frost warnings sound, the big fans will draw air from the comparatively warm layer that exists twenty-five feet above the ground and shoot it downward to mix with the colder air below. Four such devices are said to protect a ten-acre orchard when set at the corners as shown in the diagram. If a larger area is to be guarded, the four-cylinder motor that turns the propeller also revolves the whole machine on its tower, much like an oscillating fan.

Clouds in the night sky reduce frost danger by retarding the earth's loss of heat by radiation. Bell-jars and paper blankets placed over small plants have a similar effect. But outside heat, such as fire-pots scattered through an orchard, has hitherto seemed most effective. Growers hope the new wind machines will perform as well on a gigantic scale and in the end prove more economical.

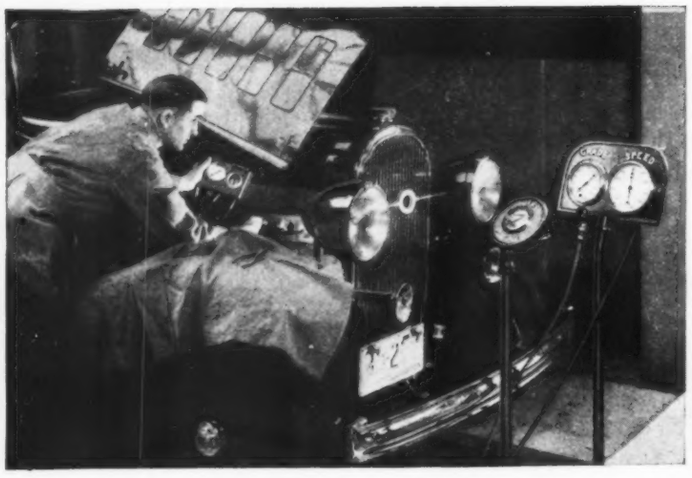
FRENCH BICYCLE HAS SMALL FRONT WHEEL

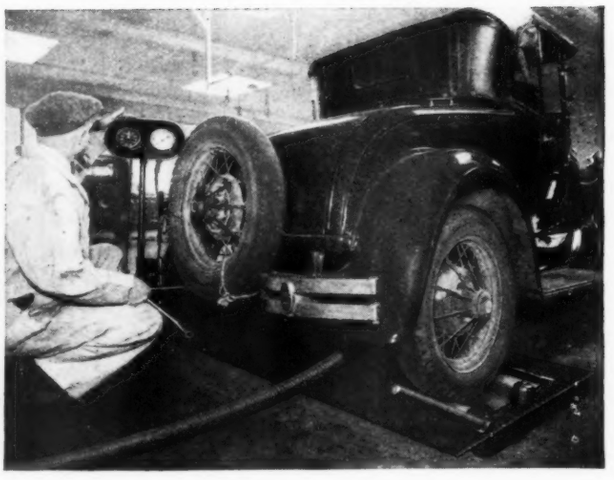
RETURNING to the design of an old-fashioned bicycle, a French inventor is producing one with a small wheel in front and a large one behind. The small wheel steers, while the large one drives. Handlebars are at the rear of the cyclist. The inventor claims his machine embodies scientific principles of balance and structural design. Its rider sits in a comfortable erect position, instead of crouching, so obstructions are unlikely to throw him.

ELEPHANT SERVES GAS TO MOTORISTS



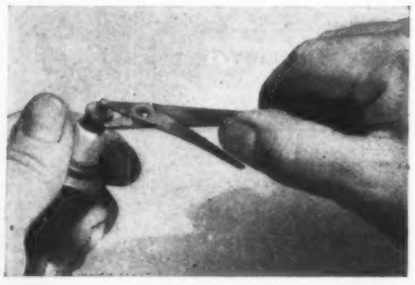
A MOTORIST who passes through the little town of Chateauroux, in central France, may stop and fill his gasoline tank at one of the strangest filling stations in the world. The owner, with an eye to attracting trade, has fashioned a housing for his filling pump in the shape of a monstrous elephant with upraised paw. The customer receives the desired number of liters (a French measure slightly larger than a quart) from a hose drawn out of the elephant's leg. Since the site marks the intersection of several highways, the elephant station has attracted attention and is always busy.





Car Is Run on Rollers in Garage to Locate Motor Noises

NO LONGER need a car owner, seeking diagnosis of an elusive knock, prevail upon a busy garage mechanic to drive with him around the block. A testing device perfected by a Seattle, Wash., inventor, and already installed in a number of garages, permits a car to "run" at road speed in a garage. Its rear wheels spin upon rollers, shown above at upper right, which may be braked to simulate a hill. Meanwhile the mechanic checks up on the motor's behavior, as shown at upper left, with the aid of gages that indicate the car's speed in miles per hour and the motor speed in revolutions per minute.



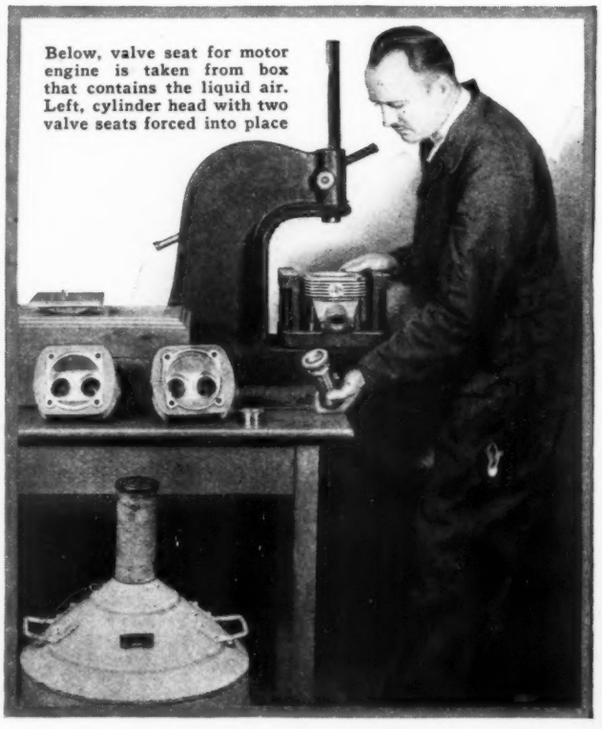
SPARK PLUG TOOL HAS FOUR USES

A FOUR-IN-ONE spark plug tool has just been devised by a Chicago inventor. It comprises a toothed slot for turning the knurled nut and a pivoted prong for testing ignition or scraping off carbon. The edge of the main blade is a spacer for the points.

STEM OF FOLDING PIPE IS HINGED TO BOWL

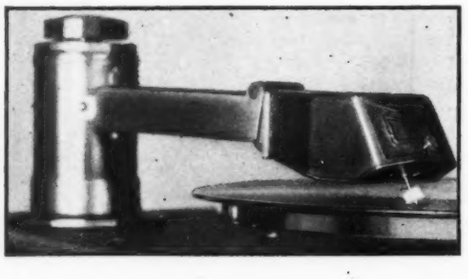
EASY to clean is a folding pipe, recently placed on the market. The stem, hinged to the bowl section, may readily be unfastened. The pipe is carried in a compactly folded position, and is said to be less liable to breakage than one of conventional design.

USE LIQUID AIR TO ASSEMBLE MOTOR



Below, valve seat for motor engine is taken from box that contains the liquid air. Left, cylinder head with two valve seats forced into place

LIQUID air has been pressed into service by airplane engine makers. In assembling an engine, it is necessary to insert a pair of valve seats—two-inch rings of aluminum bronze—in each cylinder head. To get a tight fit, holes for the rings are now bored exactly eight-one-thousandths of an inch undersize in the cylinder head. It is then expanded in a tank of boiling water. Meanwhile the valve seats are shrunk by chilling in a wooden box filled with liquid air. Chilling and heating eliminate the size discrepancy and little pressure is needed to force the parts together. At normal temperature, they are as tight as if fused together with the result that they give a highly satisfactory service.

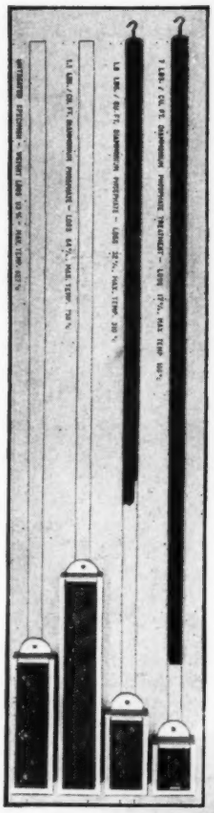


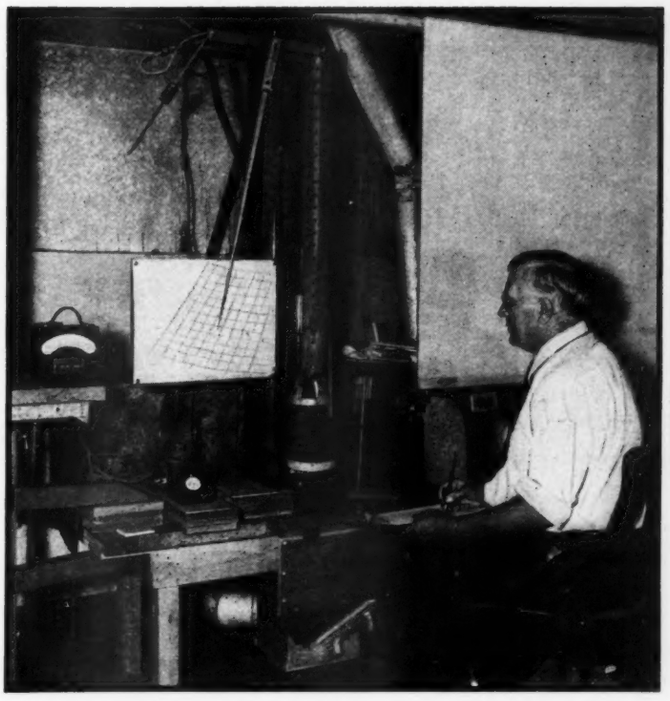
RECORDS CLEANED BY PHONOGRAPH NEEDLE

DUST and dirt are removed from the sound tracks of phonograph records with the cleaning needle shown at the left. The felt pad, which can be seen at the end of the needle, not only cleans but is said to reduce scratching and prolong the life of a record by removing all grit.

New Tester Shows Burning Rate of Fireproofed Wood

A NEW type of tester to determine the effectiveness of various types of chemicals for fireproofing wood has been designed at the U. S. Forest Products laboratories at Madison, Wisc. The tester consists essentially of a tube in which the specimen to be tested is placed, a Bunsen burner with a controllable flame, and a scale registering the specimen's change in weight. By this means the chemist can now determine the rate at which fireproofed wood will burn. In the laboratory tests, diammonium phosphate has proved best for fireproofing purposes. In the accompanying picture the results of tests of wood, impregnated to various degrees with this chemical, are shown. Work is now in progress to find substitutes for the phosphate that will be equally effective and more economical. Several testers, made at the University of Wisconsin, have been sent to various other governmental agencies.





The rate at which fireproofed wood burns is registered on the scale, left, of this new tester. At left, tested samples that burn at different rates

LIFE-SAVER ON BUS SCOOPS UP VICTIM

AN AUTOMATIC life-saving device is built into a sixty-three-passenger bus just placed in service in England. The apparatus makes it virtually impossible to run over a pedestrian. Contact with a body actuates triggers beneath the front of the bus, automatically dropping a hinged frame that scoops up the victim from in front of the wheels. Thus he suffers only a shaking up instead of possibly fatal injury if the driver is unable to apply the brakes quickly enough. The photograph below was made during a recent demonstration of the device.

Automatic scoop on front of this bus drops to catch victim, as photo shows, and saves his life

Three gasoline tanks on this car, equipped with control devices, enable engineer to test gas of varying grades

CAR TESTS THREE GRADES OF GAS

WHEN G. L. Young, western petroleum engineer, stops at a service station, he buys gasoline from three pumps at a time. His car is equipped with a triple set of fuel tanks and carburetors to allow him to compare the performance of various types and makes. Any desired fuel is made available in a moment by a control operated by the driver. Results of his tests are useful to him in his capacity as chief engineer of a large oil company. Young says that the lowest grades now sold are not bad gasoline, but higher-priced grades are better for quick starting.

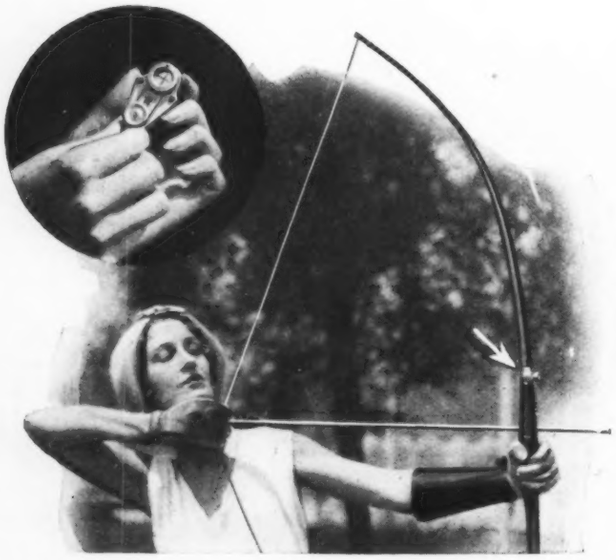
PHOTO PLATES "READ" BURNED PAPERS

WHEN valuable documents were charred beyond recognition in a recent Wisconsin fire, it was thought their contents were forever lost. A police scientist took them, however and made them reveal their meaning. The charred remains were firmly compressed between two photographic plates and left in total darkness for three weeks. When immersed in developer, the plates showed images of the documents. The process depends upon the different rates of chemical reaction between ink and paper.

Upper half of this picture shows the condition of the charred documents and lower half shows what photo plates revealed on them

MYSTERIOUS COSMIC RAYS TRAPPED FOR STUDY IN SCIENTIST'S BASEMENT

STUDY of cosmic rays, mysterious radiations from space, more penetrating than X-rays, has been brought out of the laboratory and placed on a more homely basis by recent tests. Putting in his own basement the bomb-like detector shown in the photograph above, Dr. Robert A. Millikan, California physicist (right) found the rays streamed through the roof and walls of his house without appreciable hindrance. Meanwhile University of Chicago experimenters accidentally discovered that the human head absorbs five percent of the cosmic rays that strike it while the rest pass through.



SIGHT ON BOW HELPS ARCHER'S AIM

AN ARCHERY sight, said to improve the accuracy of bow-and-arrow shots fifty percent, was recently demonstrated at Los Angeles, Calif. In aiming at a distant target, an archer must point his arrow well above it. Consequently, at the moment of releasing the bow string, he does not see the target. In the past he has had to depend largely upon his "feel" of the distance to score a hit. The archery sight contains two prisms which deflect the light enabling the archer to see the bullseye and to aim his arrow so it leaves the bow at the right elevation. The sight may be adjusted for distance.

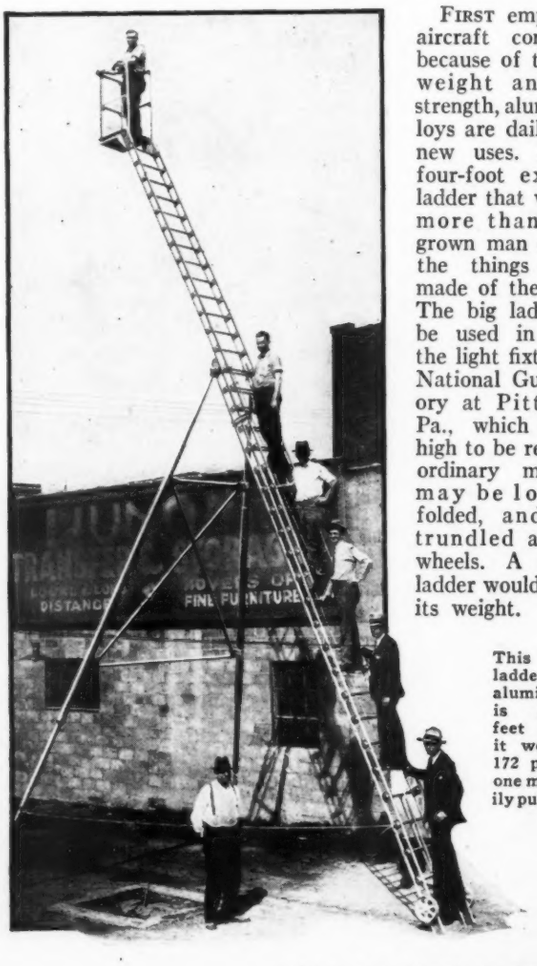
GUNS CLEAN CEMENT KILNS

BLAZING away with repeating shotguns, workers in a middle-western cement factory now clean out kilns in which hardened cement has formed. In the past, to clean out the cement the kiln had to cool off and then men with sledge-hammers would enter and break away the cement. By using long-barreled shotguns and No. 12 shot, the rings are now knocked loose at a great saving in time and money.

Shotguns are used to loosen cement that has hardened inside the kilns. Formerly men with sledge hammers knocked these rings of cement loose

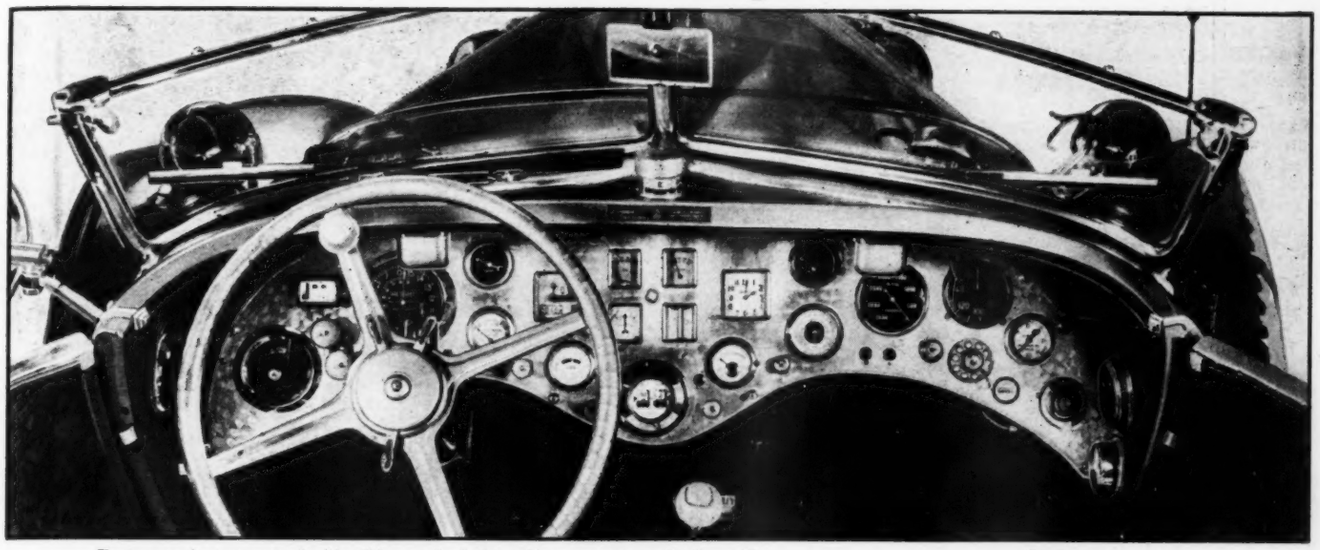
ONE MAN HANDLES THIS BIG LADDER

FIRST employed in aircraft construction because of their light weight and great strength, aluminum alloys are daily finding new uses. A forty-four-foot extension ladder that weighs no more than a full-grown man is one of the things recently made of these alloys. The big ladder is to be used in cleaning the light fixtures of a National Guard armory at Pittsburgh, Pa., which are too high to be reached by ordinary means. It may be lowered, folded, and easily trundled about on wheels. A wooden ladder would be twice its weight.

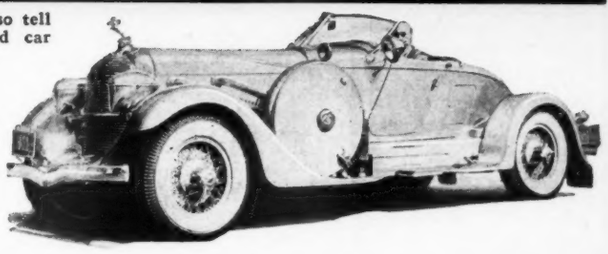


This extension ladder, made of aluminum alloys is forty-four feet long but it weighs only 172 pounds and one man can easily push it around

Fifty Instruments Help Run This Car

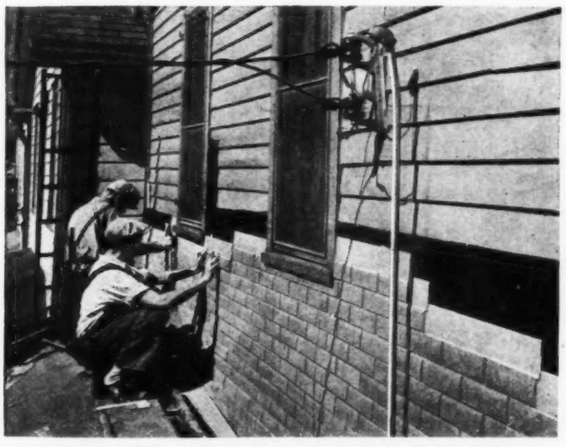


Forty-one instruments inside this car include ordinary gages and also tell altitude and weather. Right, exterior view of the super-equipped car



COLLECTING instruments to place on his automobile is the unusual hobby of Lawrence Grayson, of Los Angeles, Calif. Forty-one, to date, grace his car's driving compartment, with nine more outside. Besides regulation motor instruments they include such novelties as a barometer for foretelling the weather, an altimeter to show Grayson his elevation, an airspeed indicator, a periscope, a compass, and a device that shocks a would-be car thief by releasing an electric charge of 32,000 volts.

IMITATION BRICKS FOR OLD HOUSES



Thin bricks of Portland cement and asbestos fiber laid over wood siding of a house, transform it into a modern dwelling

OLD frame houses are given a handsome new exterior by means of an imitation brick recently introduced. The brick, consisting of thin slabs made of Portland cement and asbestos fiber, are laid directly over the wood. The result is a modernized dwelling difficult to distinguish from one of real brick. Not only does the coating improve the appearance of a home, according to the maker, but it also serves as an insulating blanket that will keep the house warmer in winter and cooler in the hot summer days.

REINFORCED CELLOPHANE NOW USED AS WINDOWS

USING cellophane as a substitute for glass is the latest application of this versatile material. To serve as temporary windows in buildings during construction or remodeling, a flexible and waterproof cellophane sheet backed on one side by a mesh fabric has been introduced. While admitting light, it keeps the heat in and the rain out. Dust can be washed off.

Flexible cellophane, reinforced with a mesh fabric, is now used as temporary windows

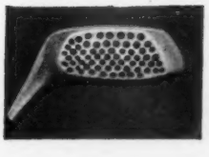
DUAL VOLTAGE BATTERY STARTS COLD ENGINE

TO OVERCOME hard starting during the cold winter months, a novel dual voltage automobile battery has just been placed on the market. Its four cells normally deliver the usual six volts. When a cold motor must be started, however, a push button on the dashboard actuates an electromagnetic switch on the battery (indicated by arrow) and alters the connections on the last two cells from parallel to series, boosting the power of the battery to eight volts. This turns over the starting motor rapidly and insures a hot spark for ignition.

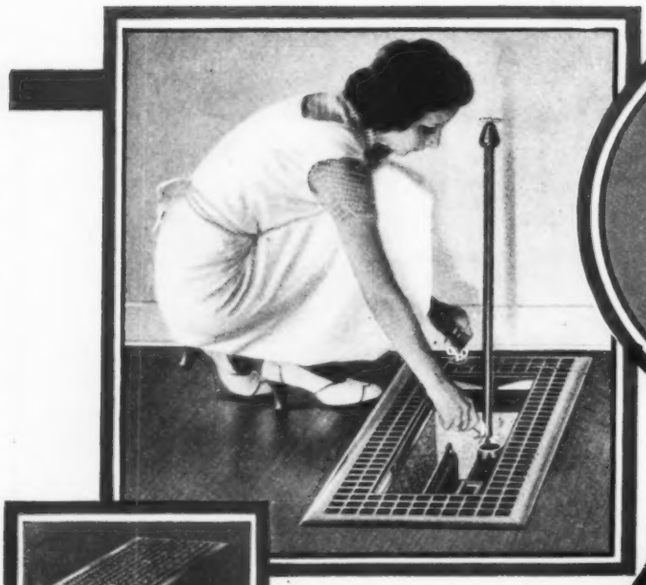
Dual voltage battery with switch, indicated by the arrow, can be stepped up to start an auto

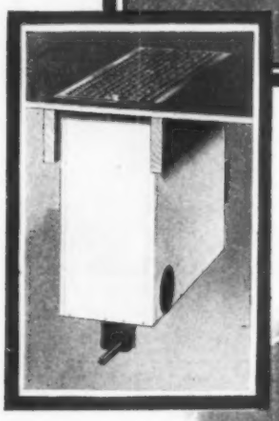
PERFORATED CLUB HEAD LENGTHENS GOLF SHOT

LONGER shots are made possible with a new perforated golf club, according to the inventor. Holes drilled in the head enable air to pass through without hindrance, so that air resistance will not retard the swing. Thus the full power of the player's stroke is expended upon the ball.

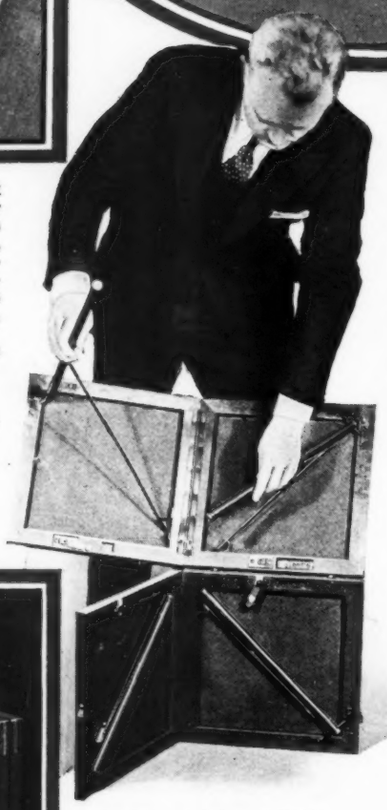


Handy Aids FOR Homemakers



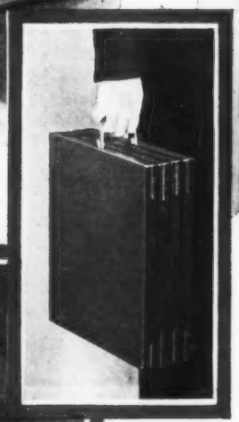


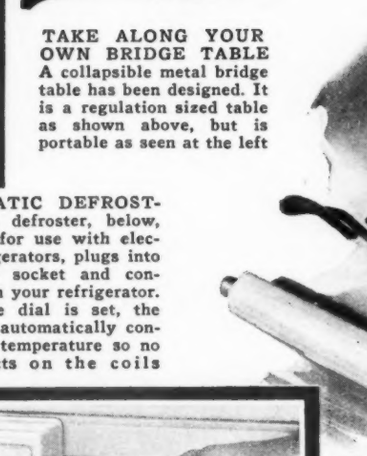
INVISIBLE GAS HEATER Looking like the heat register of a hot air furnace, the gas heater shown at left and above, is suspended in a metal box beneath the floor. The burner, radiator, and air ducts are in this box and only the grating, through which the heat escapes into the room, is seen



TIME FOR THE MEDICINE In the handle of this spoon is a clock face so it is easy for the patient or nurse to see when it is time for the next dose which can be administered out of the spoon

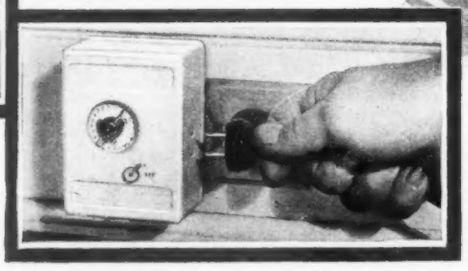
CUTTER OPENS PAPER CARTONS. Discarded razor blades, set in an oak handle, which is provided with a guiding flange for cutting along the top of a carton, make a knife with which paper containers are readily opened





TAKE ALONG YOUR OWN BRIDGE TABLE A collapsible metal bridge table has been designed. It is a regulation sized table as shown above, but is portable as seen at the left

AUTOMATIC DEFROSTER. The defroster, below, designed for use with electric refrigerators, plugs into any floor socket and connects with your refrigerator. When the dial is set, the defroster automatically controls the temperature so no ice collects on the coils

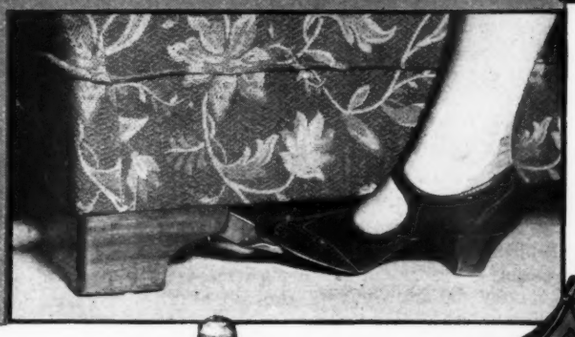


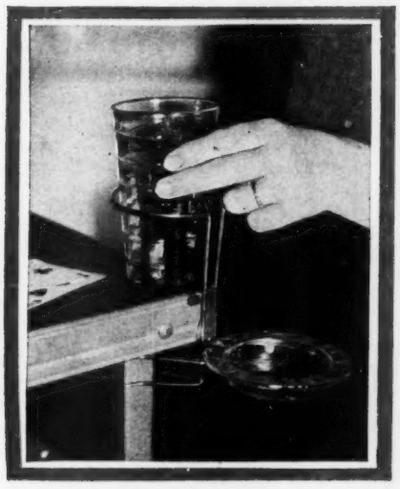
ELECTRIC WAX CANDLES Real wax candles are now provided with an electric wiring so they can be lighted with a low power bulb. An attachment comes with each which reduces the voltage to level suited to the bulb

PERFUME FOR DRESSER DRAWERS Made flat like a compact, the new type sachet shown above, will hold a whole bottle of perfume and permit it to escape into a drawerful of linen so slowly one filling will last months

STUDIO DIVAN AND TWO BEDS BUILT IN ONE.

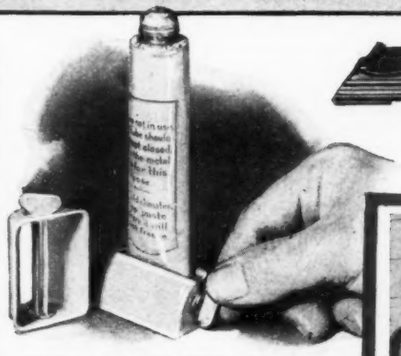
The studio divan, shown above, opens to form the twin beds, upper right, or it will open to form one full sized bed if desired. Pressing the lever, right, with tip of toe releases the mechanism that makes divan a bed





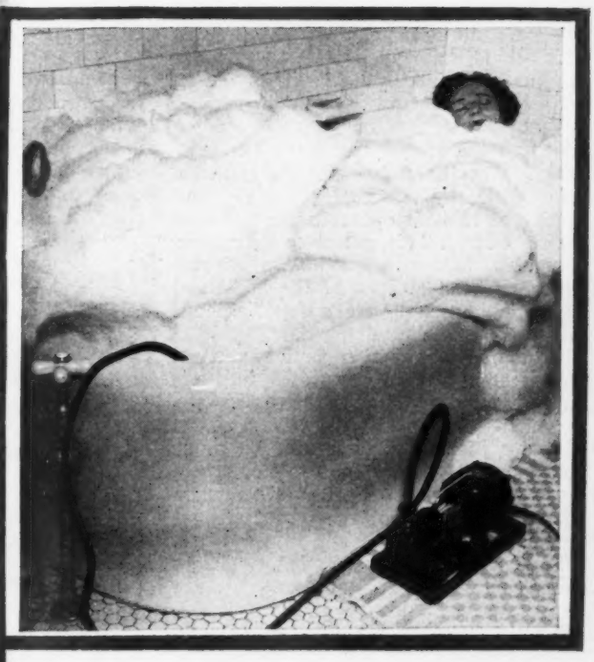
PROTECTS BRIDGE TABLE. This fixture snaps onto the leg of a bridge table and provides a holder for glasses so they cannot be tipped over. It also is a convenient and practical ash tray

CLOCK WITHOUT HANDS. Neither hands nor face are needed on this new style of clock. Electrically operated, the time in hours and minutes appears always in the window

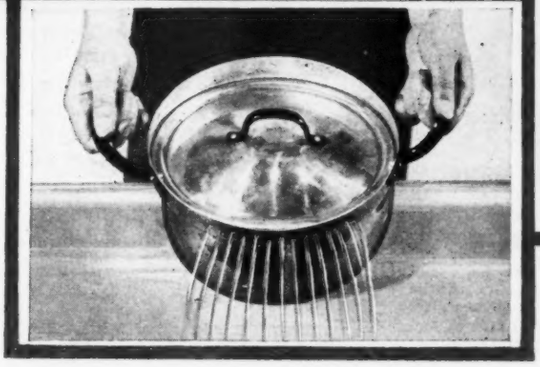


TOOTH PASTE TUBE HOLDER. Into the base, seen above, a tube of tooth paste is set. The contents can be squeezed out with no waste

ASH TRAY AND TOBACCO HOLDER. The smoker's stand, left, has a top that swings out of the way exposing a drawer to hold tobacco, pipe, and cigarettes. The ash receiver runs the full length of the stand and may be easily lifted out



A BLANKET OF SOAPSUDS. This portable electric pump forces air into the water in the bathtub giving the bather the suggestion of a rocking surf. When soap is added to the water a blanket of soapsuds, as shown, is formed by the pump



COLANDER PART OF STEW POT. Around the top of the pot shown at right is a series of holes which permits the liquid to be poured off without removing the contents. Two pins hold the lid firmly so it can't fall off

Chemicals You Can Make

MAKING MAGIC SMOKE WITH YOUR HANDS
If the dampened stoppers from bottles of ammonia water and muriatic acid are brought together, thick white fumes will rise first from the acid stopper and then from the ammonia stopper. If the palm of one hand is moistened with muriatic acid and the palm of the other with ammonia water, smoke will rise when hands are brought together as shown at left

Acids and Alkalies Easily Combine to Form New Substances You Can Use in Experiments

By
RAYMOND B. WAILES

BY EXPERIMENTING with acids and alkalies, the amateur chemist can make many of the chemicals he uses in his home laboratory. In this way, simple reactions, that require little equipment, become profitable, interesting, and instructive.

When an acid and a base combine in the right proportions, a new substance is formed. Sal ammoniac, for instance, can be made by holding an unstoppered bottle of ammonium hydroxide (household ammonia will do) next to the open mouth of a hydrochloric (muriatic) acid bottle. The sal ammoniac appears as a dense white cloud that will float in the air and eventually disappear.

This novel reaction forms the basis of an interesting experiment that can be added to the amateur magician's bag of tricks. Wet the stopper of the muriatic acid bottle, by shaking the bottle, and touch the moist stopper to the palm of the right hand. This will place a harmless amount of acid on the skin. Do likewise with the moist stopper of the household ammonia bottle, placing a small amount in the palm of the left hand.

To the casual observer, both hands will appear empty. However, when they are cupped together and the two thumbs placed to form an exit hole, dense clouds of white fumes will pour out. To prove your hands are empty you can move them apart only to place them together again and produce more of the mystifying sal ammoniac smoke.

Similarly, two apparently empty glasses —one containing a drop of ammonia water and the other a drop of muriatic acid— will smoke when they are placed together.

In combining, the acid and the base in each case neutralize each other to form a new substance—sal ammoniac (ammonium chloride). Chemists call this reaction neutralization and make use of it as a test for computing the relative strengths of chemicals as well as a means of producing other chemicals.

Neutralization can be demonstrated in the home laboratory with the aid of an indicator such as an alcohol solution of phenolphthalein obtainable at any drug store.

First make up a limewater solution by dissolving lime in water. Shake it vigorously for several minutes and allow it to settle. Then carefully pour off the clear upper liquid.

Next place one drop of muriatic acid in a beaker and to this add some water and a drop of the phenolphthalein solution. Then with a medicine dropper, slowly add the limewater to the acid solution in the beaker, counting each drop as it falls and stirring the acid continually. Add the limewater in this way until a single drop colors the liquid red. When the red color remains for at least a quarter of a minute it indicates that enough limewater has been added to neutralize the acid.

You will probably find that about 240 drops of the limewater will be needed to neutralize the single drop of muriatic acid. By repeating the test with other bases, their strengths can be compared.

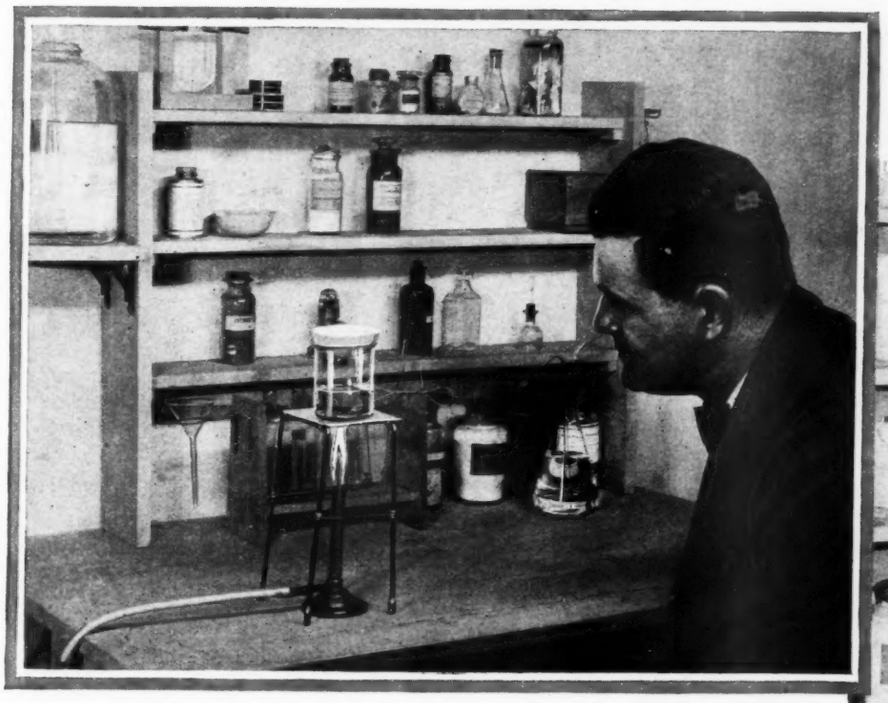
In a similar manner, a weak lye solution made by dissolving several pea-size pieces of lye in a half pint of water can be used for comparing the relative strengths of vinegars (acetic acid). The stronger the vinegar, the greater will be the amount of lye water needed to neutralize it. Of course, it is important that the same quantity of vinegar be used in

GRINDING A GLASS STOPPER
Valve grinding compound is put on the glass stopper and it is then twisted back and forth inside the neck of the bottle to wear it to proper size. It must also be pushed in and out to keep it perfectly round

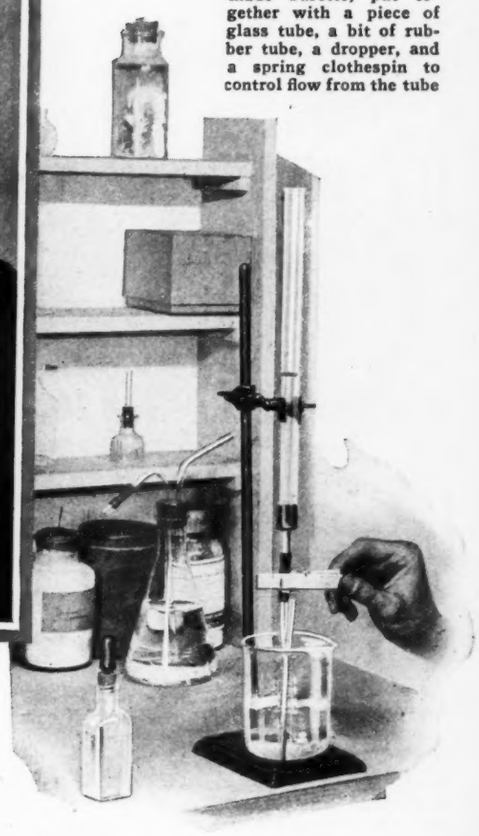
Common Substances That Can Be Used in the Home Laboratory

COMMON NAME	CHEMICAL NAME
Alum	*Potassium aluminum sulphate*
Bleaching powder	*Calcium hypochlorite*
Boracic acid	*Boric acid*
Borax	*Sodium tetraborate*
Calomel	*Mercurous chloride*
Chalk	*Calcium carbonate*
Copperas	*Ferrous (iron) sulphate*
Cream of tartar	*Potassium bitartrate*
Epsom salt	*Magnesium sulphate*
Glauber's salt	*Sodium sulphate*
Limewater	*Calcium hydroxide solution*
Lye	*Sodium hydroxide*
Quicklime	*Calcium oxide*
Rochelle salt	*Sodium potassium tartrate*
Sal ammoniac	*Ammonium chloride*
Sal soda	*Sodium carbonate*
Salt	*Sodium chloride*
Washing soda	*Sodium carbonate*
Water glass	*Sodium silicate solution*

in Your Home Laboratory



The chemical made by neutralization can be recovered by use of the steam bath as shown above. The liquid is evaporated by the heat from the beaker and the precipitate is left



Below is shown a homemade burette, put together with a piece of glass tube, a bit of rubber tube, a dropper, and a spring clothespin to control flow from the tube

each test and that the lye water be of uniform strength.

Tests of this sort are referred to by the industrial chemist as *titrations* and a special measuring tube used to drop the one liquid into the other is called a *burette*. Commercial burettes are expensive but the home experimenter can make a good substitute from several feet of half inch diameter glass tubing, a medicine dropper, some rubber tube, and a spring clothespin as shown in the photograph on this page.

THE long glass tube is fitted with a stopper through which projects the end of a small glass tube. The glass portion of a medicine dropper is connected to this projecting tube by means of the short length of pliable rubber tubing. The spring clothespin, placed over the rubber tubing as indicated, serves as a valve for controlling the flow of liquid from the tube.

On commercial burettes, divisions etched on the long glass tube tell how much of the liquid is used in each titration. With the homemade burette, the amateur chemist can obtain a similar result by keeping an accurate count of the drops falling from the tip. If desired, an olive bottle with its bottom removed can be substituted for the large diameter glass tubing.

By neutralizing sodium hydroxide (lye water) with dilute sulphuric acid, the home chemist can make sodium sulphate. Place the acid in a beaker or other convenient glass container and add a drop or two of the phenolphthalein solution. Fill your homemade burette with the weak lye solution and adjust the clothespin so that the solution drops slowly into the beaker.

As before, when one drop of the alkali (base) turns the solution red, neutralization is complete and the beaker will contain sodium sulphate in solution. The solid sodium sulphate can be obtained by heating the solution until all the water has been driven off. This can be done by boiling the solution until only a few ounces are left and placing the remainder on a water or steam bath as described last month. When all the water has been evaporated, white sodium sulphate remains and this can be bottled and labeled.

Neutralization produces heat. If the solution becomes too hot during the above process, add a little water to the beaker.

Acids and bases also can be made to react with salts to form other chemicals for use in the amateur's laboratory. Epsom salts, chemically known as magnesium sulphate, can be used in making several magnesium compounds.

MAKE a solution of Epsom salts in water, place it in a beaker, and to it add lye water. A white precipitate will be formed. Allow the beaker to stand for some time and you will notice that the white precipitate settles to the bottom.

When it has completely settled, add one or two more drops of the lye water. If more precipitate is formed, add more lye water and again wait for the precipitate to settle. Test the clear liquid with a few drops of lye water as before and repeat the process until no precipitate is formed.

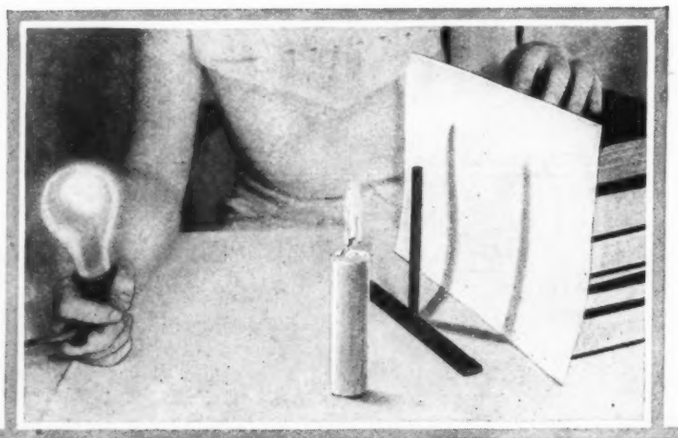
The white substance resting on the bottom of the beaker will be magnesium hydroxide. Pour off the liquid, add clear water, shake it, and again pour off the liquid. Repeat this several times to wash the magnesium hydroxide thoroughly. After several such washings, test for the presence of lye water in the clear wash liquid by using litmus paper or phenolphthalein solution. Red litmus will turn blue and the colorless phenolphthalein solution will turn red if the slightest trace of lye water remains. If necessary, further washings will remove every trace of the caustic.

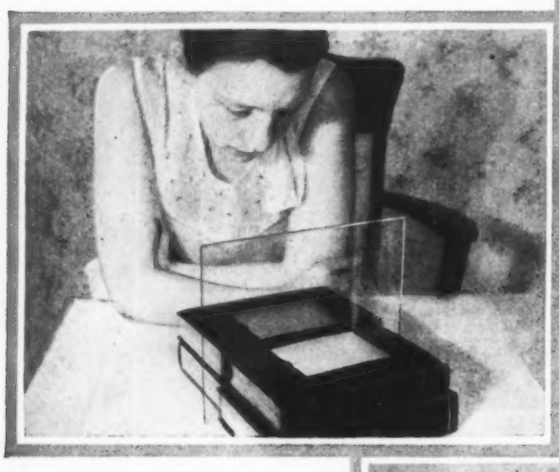
PLACE the precipitate in an evaporating dish and remove the water that remains by placing it on a water bath. Then heat the dish until the precipitate is dry. The heat changes the original magnesium hydroxide into magnesium oxide or magnesia. If this is dissolved in muriatic (hydrocholoric) acid, magnesium chloride will be formed. The solid magnesium chloride can be obtained for bottling through the use of a water bath.

When dissolving the magnesium oxide in the acid, use more of the oxide than the acid. In this way, not all of the oxide will be attacked. Filter and then evaporate the water. This will prevent the final product from being contaminated with the acid.

If the magnesium oxide is dissolved in nitric acid, magnesium nitrate will be formed. If it is dissolved in sulphuric acid, magnesium *(Continued on page 99)*

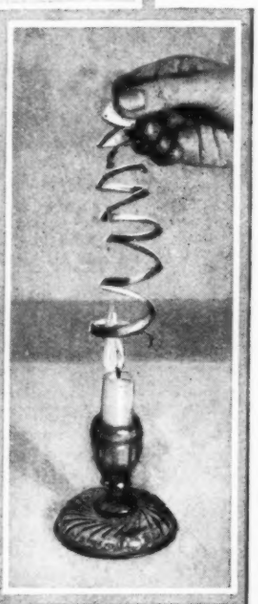
Stunts
TO DEMONSTRATE
Natural Laws
Scientific Facts Tested with Simple Apparatus



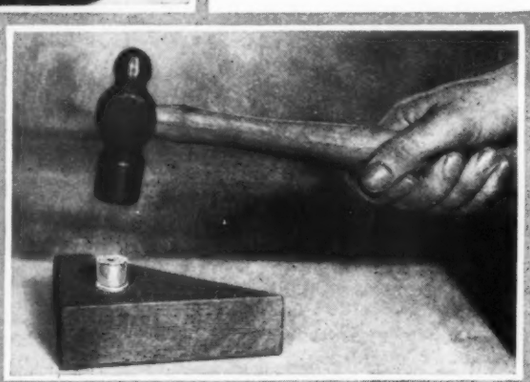


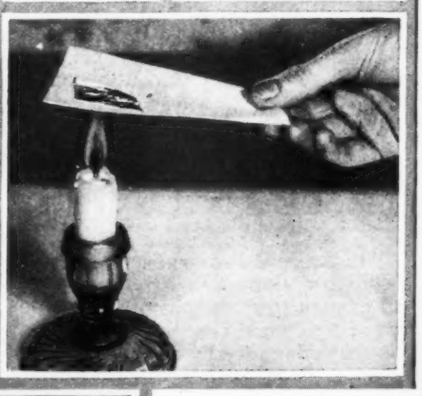
HOW STRONG IS YOUR LIGHT BULB? The candle power of any light can be determined with approximate accuracy in the manner illustrated above. An upright rod is placed in front of a sheet of white paper. A candle and a light bulb are arranged to throw shadows at different angles. Move the light bulb back until the shadows are of the same intensity. Since the intensity of the light varies inversely as the square of the distance of the screen from the source, a simple calculation gives the candle power of the bulb

WATCHING METAL EXPAND. Cut a small spiral from a sheet of tin. Hold this spiral, as shown at right, over a candle flame. The expansion due to heat will be easily seen as the tin stretches when hot and contracts as it cools off



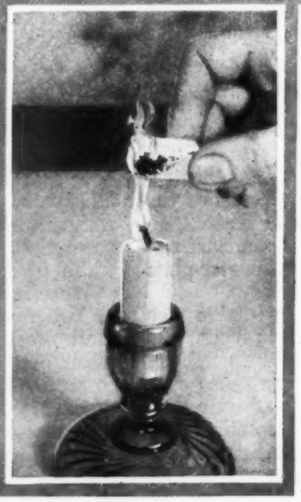
COLORS MIXED WITH GLASS When yellow and blue paints are mixed, they produce green. However, an entirely different result is gained with light rays reflected from yellow and blue paper as illustrated above. When two pieces of paper are arranged with a sheet of glass set between them, the observer, looking at the nearer paper, will see a dull shade of gray. This is due to fusion of the light rays rather than to a blend of pigment as is the case in the use of paint





A NEEDLE THROUGH A COPPER DISK Press a needle straight through the center of a cork. Place the disk on a block of wood and on top of the disk put the cork and needle, the head of the needle being flush with the top of the cork. If the needle is hit sharply, straight down, it will pierce the copper

CAPILLARY ATTRACTION A tumbler is filled even full of water. A piece of blotting paper, lying on a sheet of glass, is pressed down on top of the tumbler so the water will meet the paper. The tumblerful of water may then be lifted with the plate glass. This is due to the capillary attraction



FIREPROOF PAPER Place a small piece of tinfoil on a sheet of paper and hold the paper over a flame. It will surprise you to see that the paper will not burn until the tinfoil has melted. This is due to the rapidity with which tinfoil conducts heat, thus keeping the temperature of the paper so low that it cannot burn

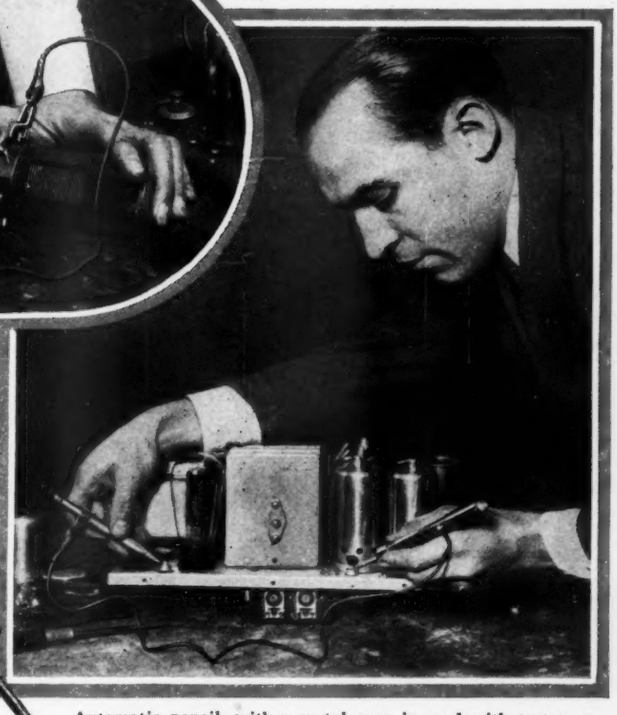
MAGNETIC GLASSES. In one of the glasses place a lighted candle. Smear the edges of both glasses with lard. Invert one glass over the other as shown. Soon the candle goes out, and the glasses stick together, held by the vacuum that was created by the oxygen-consuming candle flame

MAKING SUGAR BURN As you know sugar melts without burning with a flame. Place a pinch of cigarette ashes on a piece of sugar and hold it in a flame. Due to the catalytic action of the ash, the sugar will burst into flame

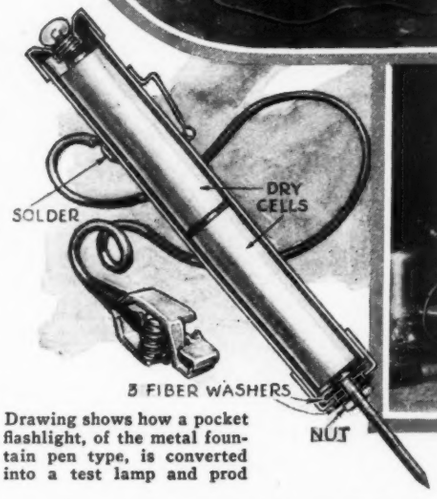
Homemade Test Lamp *for* RADIO

Pocket Flashlight Readily Converted into Handy Tool—Self-Locking Lugs for Portable Sets

In using flashlight tester, wire is clipped to one terminal and the prod placed on the other



Automatic pencil, with a metal case is used with tester as shown above in making tests where two prods are convenient



Drawing shows how a pocket flashlight, of the metal fountain pen type, is converted into a test lamp and prod

MADE from an inexpensive flashlight of the metal fountain pen type, the combination test lamp and prod illustrated at the right is a compact tool for the handy man's radio kit.

Aside from the flashlight, which can be purchased in most five-and-ten-cent stores, all that is required is a machine screw and nut, three fiber washers, some insulated wire, and a small battery clip.

The machine screw is inserted through a hole drilled in the closed end of the metal flashlight case. The head of the screw forms the contact for the zinc body of the lower flashlight cell and the outer end, when filed or ground to a tapering point, forms a convenient test prod.

Three fiber washers are used to insulate the prod from the case, large washers being placed inside and outside and a smaller one being fitted between as indicated in the sectional drawing. A nut holds the washers and machine screw in place.

The prod forms one terminal of the test lamp circuit. The other terminal is a small spring clip soldered to a length of insulated wire which in turn is soldered to the metal case of the flashlight. When used in testing small coils, fuses, and similar parts, the tiny lamp will light if the circuit is unbroken. It can also be used to test condensers for short circuits. Such a tester, it should be understood, can not be used where any great amount of resistance is involved.

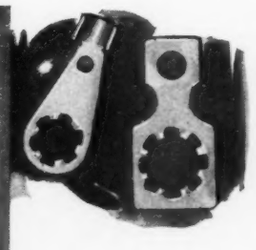
An automatic pencil having a metal case can be fastened to the clip terminal and used as a second prod if desired. By supplying the prod with a cloth or leather cover to insulate it from the clip, the combination test lamp can be carried in the vest pocket like a regular fountain pen.—GEORGE JOHNSON.

EASY WAY TO FIGURE VOLTAGE ADJUSTMENT

RADIO experimenters who design their own battery-operated receivers can calculate easily the size of the variable resistor to be connected in series with the filaments or heaters of the tubes and the power source. By a simple application of Ohm's law, the required resistance in ohms is equal to the difference between the supply voltage and the rated voltage of the type tube being used, divided by the total rated filament current for the tubes.

For a series connection of type '36, '37, '38 or '39 tubes in receivers operating from a direct current house line, the required resistance to be placed in series with the heaters can be found in a similar manner. Subtracting the sum of the tube voltages from the line voltage and dividing by the heater current in amperes for a single tube gives the value of the resistance in ohms.

The various rating values are given on a slip of paper packed in the box with the tube.



Self-locking terminal lugs, above and at left, will insure tight connections on portable radio sets. Note twisted teeth on the inner surface of the lugs

SELF-LOCKING LUGS CAN'T VIBRATE LOOSE

WHEN building an automobile receiver or any type of portable radio, the danger of having binding post connections shake loose can be eliminated by using the self-locking type of soldering lug shown in the illustration.

Having a series of curved spring-like teeth surrounding the portion of the connector that fits over the terminal, this ingenious lug grasps the surfaces of the binding post nut and base to hold it firmly in place and prevent the nut from vibrating loose. These combination lugs and lock washers can be obtained in a large variety of different shapes and sizes to meet every radio need. Separate lock washers of the same type are also available to the home experimenter.

Simple Radio Phone

FOR USE OF AMATEURS

By John Carr

Amplifier in a modern radio set being used to modulate the *Popular Science Monthly* short wave transmitter

WITHOUT altering the original circuit in any way, the POPULAR SCIENCE MONTHLY short wave transmitter can be transformed into a practical radio telephone for amateur use. In fact, any short wave transmitter can be adapted easily for microphone operation.

Last month I outlined the principles of the radio telephone and described the equipment necessary for an experimental modulating system consisting of a carbon microphone, a battery, and a microphone transformer connected into the transmitter in such a way as to vary the plate voltage of the oscillator according to the sound waves striking the microphone diaphragm.

For the more efficient circuits shown on this page, the amateur need only supplement the equipment he used in the experiments last month with a two stage audio amplifier, a modulator tube, and a suitable output transformer or iron core choke depending on the diagram followed.

If desired, the modulator can be constructed as a unit using a B supply separate from that of the transmitter. When this is done, the circuit shown in diagram *A* should be used. By following the connections shown in *B*, the same B supply can be used.

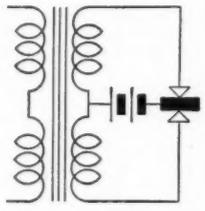
In the power circuit for the transmitter, -B should be connected to -F when using D. C. on the filament or to the exact center tap on the transformer if A. C. is used. As explained in the short wave transmitter article (P. S. M., Aug. '32, p. 65), -B is grounded.

Basically both of these systems operate in a manner similar to the elementary microphone circuit described last month. The microphone, battery, and the microphone transformer are connected into the B-supply to the plate of the oscillator, but to obtain better modulation an audio amplifier is placed in the circuit to magnify the voltage variations set up by the microphone circuit.

For best results, the audio amplifier should contain a gain control placed after the first stage. The power of the output tube or modulator connected to the two stage amplifier should be equal to or greater than the combined power of the tubes in the oscillator circuit. For the POPULAR SCIENCE MONTHLY transmitter, a type '50 tube should prove adequate.

The amateur owning a modern broadcast receiver equipped with a good amplifying system and a phonograph attachment jack, can arrange an experimental modulating circuit similar to the one shown without any additional expense. Wires wound around the plate prongs of the output tubes will serve as leads to the short wave transmitter and the phonograph jack provides a means of connecting the microphone, battery, and microphone transformer into the circuit.

When experimenting with a radio telephone, the amateur should monitor his wave before attempting to put his voice on the air. This can be done by moving his short wave receiver to another part of the house where he can listen to his own transmitter operated without an antenna. In this way he can tell just what quality he is obtaining before going on the air. It must be borne in mind that only three bands are open for amateur radio telephone use (5 to 5.36, 84.5 to 85.7, and 150 to 175 meters).



Hook up for double-button microphone

Many amateurs use the double-button microphone in preference to the simple single-button variety. This type has three connections instead of two and is used with a special split winding transformer.

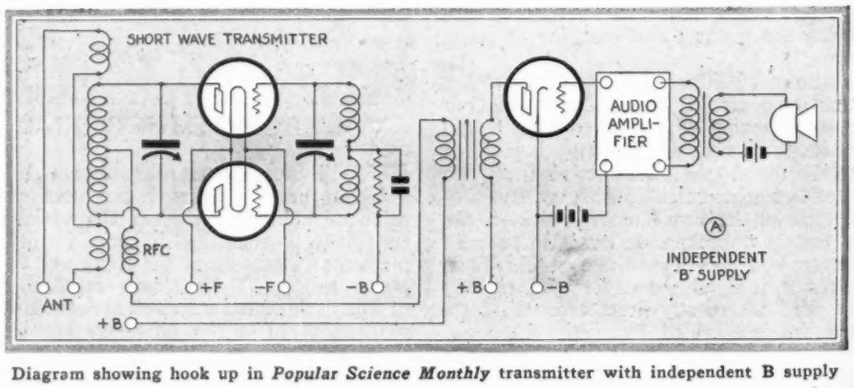
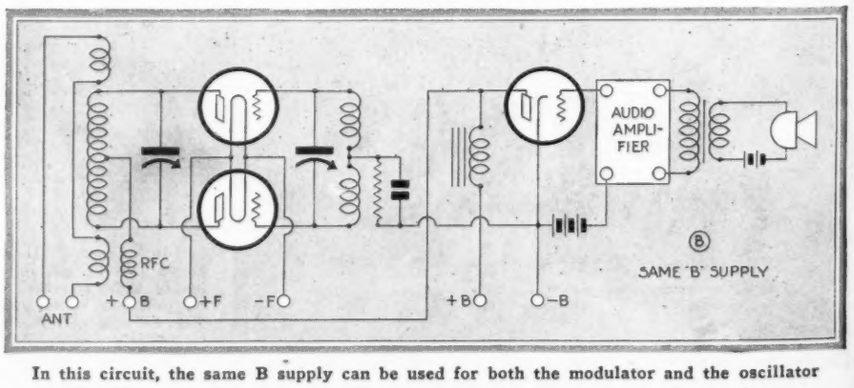


Diagram showing hook up in *Popular Science Monthly* transmitter with independent B supply



In this circuit, the same B supply can be used for both the modulator and the oscillator

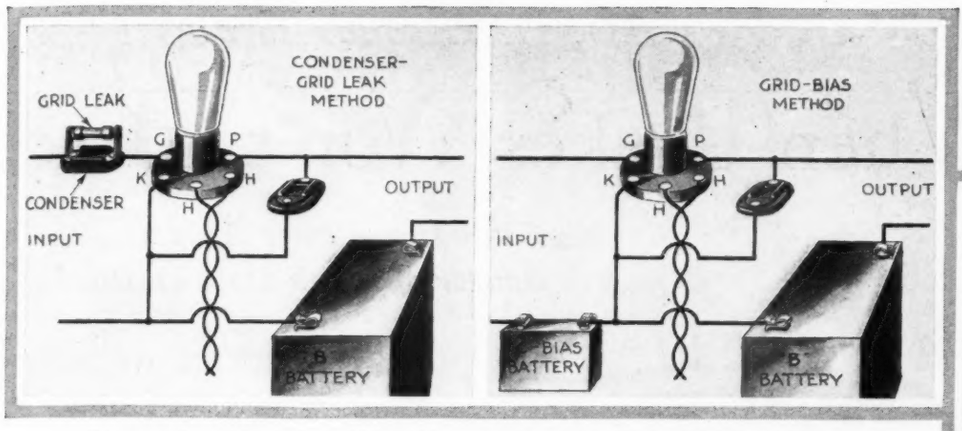
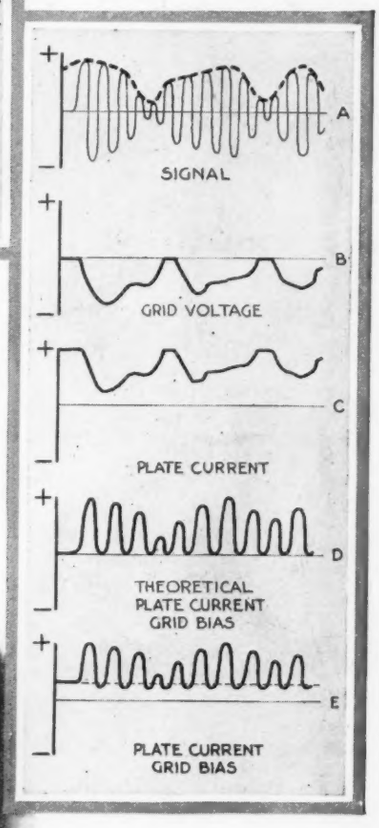


Diagram shows circuit for grid-bias detector and for a condenser-grid-leak detector

Drawing below shows how waves look when they reach receiver and the modifications that take place in the waves through the action of the detector circuit



How Detector Tube Helps Radio Set Work

By
GEORGE H. WALTZ, JR.

CONSIDERED in one way, the detector tube is the most important unit in a receiving set. Without it, the various amplifiers added to help the receiver do a better job would be worthless.

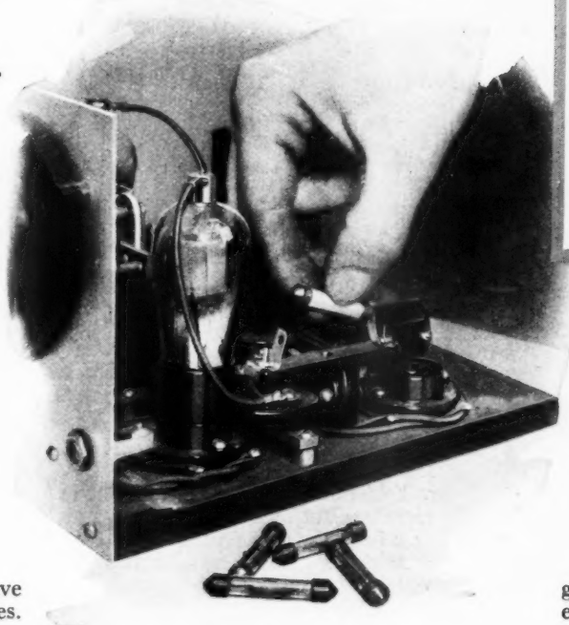
Incoming radio waves picked up by an antenna connected to our broadcast receiver can be considered as consisting of two parts —the radio frequency carrier wave and the variations in the swing of this wave caused by the electric equivalents of sound waves impressed on it at the transmitter. Graphically, the waves reaching a receiver look like *A* in the drawing at the upper right.

In this complex form, the waves have no effect on our loudspeaker or earphones. To operate these sound making instruments, one-half of the alternating carrier must be discarded and the audio or sound portion of the other half separated from it. This rectifying of the alternating carrier and extracting of the important audio-frequency portion of the wave is the job of the detector tube.

Detection, in other words, is the separation of the voice or music from the incoming wave so that it can be further amplified and finally transformed into sound by earphones or a loudspeaker.

The beginner who wants to know how the detector tube works should first familiarize himself with the simple action of any vacuum tube as described in a recent issue (P. S. M., Dec. '32, p. 55).

In common practice, a tube used as a detector can be wired as a grid-bias detector or as a condenser-grid-leak detector. The simple diagrams for both these circuits are shown in the drawing at top of this page.



Using a grid-leak mounting, various cartridge grid-leaks can be tried. The one working best can be used

The condenser grid-leak method, which is the older of the two, is based on the fact that if the grid of a vacuum tube is made positive it will act more or less like the plate and attract the negative particles of electricity, called electrons, flowing from the surface of the heated cathode. The extremely simple circuit consists of a fixed condenser connected into the wire leading to the grid and a resistance, known as a grid leak, connected across the condenser in the manner illustrated in drawing at upper left.

In a receiver, an incoming signal sets up an alternating voltage in the circuit and the grid of the detector becomes alternately positive and negative.

When the grid is positive, it acts like the plate of the tube and attracts some of the electrons flowing from the heated cathode. When the grid becomes negative, however, it no longer attracts these electrons and, by the stopping action of the grid condenser, the electrons it did collect during the positive alternation are trapped. Unlike the cathode, which is heated, the cold grid can not throw off these trapped electrons so they remain imprisoned.

During the next alternation of the signal, the grid again attracts and traps more electrons so that as the cycle is repeated the grid becomes more and more negative. As its negative charge increases, it repels the electrons flowing from the cathode with increasing strength and causes an increasingly greater decrease in the flow of electrons to the plate.

If the electrons trapped on the grid were allowed to pile up they would soon choke the tube and prevent it from operating. At this point, however, the grid leak resistance comes into play and allows the trapped electrons to leak back into the circuit between each series of waves.

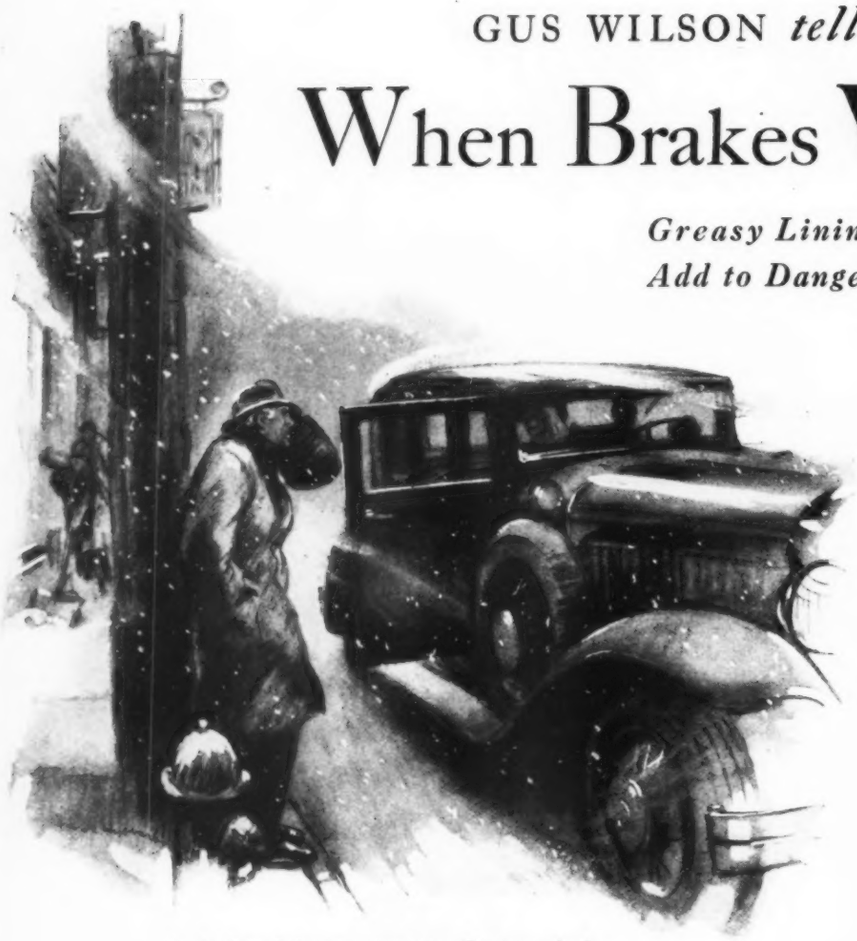
Connected into the plate circuit of the detector tube is the B-battery. As the flow of electrons to the plate is decreased by the action of the grid, the current flowing in the plate circuit therefore is also reduced. In *(Continued on page 101)*

GUS WILSON *tells what to do*

When Brakes Won't Hold

Greasy Linings and Poor Adjustment Add to Danger of Quick Stops on Road

By MARTIN BUNN



As the door of the car swung open, Gus recognized Ned Rankin, a booster for the Model Garage

FINE snow swirled along the frozen ground as Gus Wilson, hunched beside a telephone pole, waited impatiently for a crosstown bus.

"Taxi, mister?" called a voice as a snow-covered sedan came to a jerking stop in front of him.

A white curtain of snow hid the driver's face but as the door of the car swung invitingly open Gus recognized Ned Rankin, one of the best customers and boosters the Model Garage ever had.

"What's the matter, Gus, afraid to drive in the snow?" Gus Rankin grinned.

"No, just giving the car a little overhauling," replied the veteran mechanic, "and I've had so much other work, I didn't have time to finish it."

"Well, I'm in luck, running into you like this," said Rankin as Gus climbed in beside him. "I was going to stop in and see you some time today. My brakes are on the blink. You heard them squeal when I stopped just now. I've got to stand on the foot pedal to stop the car. I want you to put on some of that dressing that makes brakes hold."

"We don't keep that sort of stuff; it's only a makeshift anyhow," replied Gus. "Why not stop in at the garage and let me look at your brakes. Are the linings very old?"

"No, they've been in only about four months," said Rankin. "They can't be worn out already."

"Weak brakes can come from lots of things beside ordinary wear," Gus informed him. "The linings get glazed over, or dirt gets imbedded in the fabric, or maybe the linings get coated with grease or oil."

"The funny thing is," went on Rankin, "they hold fine when I first start out in the morning. But by the time I've driven a few miles they begin to slip."

"Sounds like grease on the linings," Gus said.

WHEN they reached the Model Garage, Gus drove the car to the rear where his repair bench was located. Joe Clark, Gus's partner, and Rankin stood close by as Gus donned his overalls and went to work.

"If brakes hold when they're cold and slip when they heat up, it's generally a sign grease is causing some of the trouble," Gus murmured as he removed one of the wheels and began scrubbing the grease-coated lining with a stiff brush soaked with gasoline. "Grease from your rear end has been leaking out. I'll have to put new grease retaining washers on when I get through, or you'll be having the same trouble all over again.

"Lucky for you, these linings aren't so bad. Sometimes so much grease gets on the brakes that a gasoline bath doesn't help. The only thing to do then is reline."

"Does water have much effect on brake linings?" Rankin asked.

"I'll say it does," Gus replied, "and it acts in two ways. If the linings just get moist, because the car has been left in a damp atmosphere, they'll grab and let out awful squeals. If they get wet through, they won't hold at all.

"WATER'S an easy thing to get rid of, though," Gus pointed out. "All you've got to do is run the car for a short distance with the brakes partly on; the heat of friction will turn the water into steam and leave the linings perfectly dry."

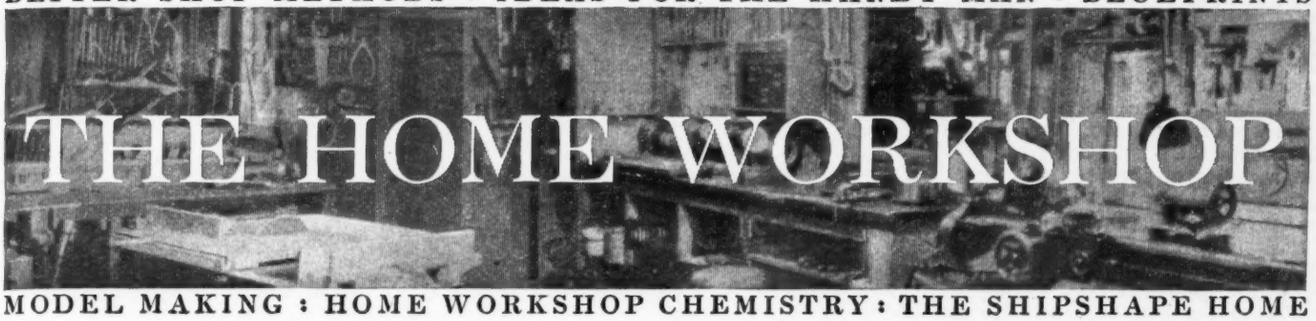
"Remember that old touring car I had some years ago?" Rankin recalled. "Everytime I'd put on the brakes, they'd chatter like a couple of pet parrots. What caused that?"

"Generally, chatter is caused by loose parts," said Gus as he put a wheel back into place, "but a broken anchor bracket or loose lining rivets will cause it too. Sometimes the brake linings get sticky and chatter, but a gasoline bath will generally remedy that.

"The hardest chatter to locate comes from poor adjustment. If the end of the brake band or shoe is forced into the drum, the lining binds at that point and generally sets up a howl. To be right, the pressure on the lining should be tangential to the drum," Gus explained.

Rankin grunted as he picked up a scrap of brake lining *(Continued on page 100)*

GUS says: **When installing spark plugs, use gaskets and be sure that each plug is screwed tightly in place. If the plugs are set at an angle or placed in the side of the motor, install them so the grounded electrodes are on the bottom side. This is particularly important on motors that pump oil. If the grounded point is placed so that it is on the top side, the excess oil will drop on the plug, drip on the insulated point, and foul it.**



A Pocketknife Model

of the new American liner MANHATTAN

By Donald W. Clark

MODEL makers who are interested in building small ship models that closely resemble the real boats and yet are not hard to construct will find just what they have been looking for in the accompanying plans for a simple little pocketknife model of the largest and finest American built ocean-going liner, the S. S. *Manhattan*.

The liner is a turbine steamship 705 ft. long over all. Her beam is 86 ft., depth to promenade deck 75 ft., gross tonnage 24,289 tons, horsepower 30,000, and normal speed 20 knots. The model is 12 in. long and has 105 parts, all of them quite easy to make. The scale of the model in relation to the full size boat is therefore approximately 1 11/16 in. equals 100 ft.

A few ordinary tools are sufficient for building the model, and it is not necessary to have a bench or any special equipment. A sharp knife to whittle the hull is the most important tool required. It must be very keen, especially for carving the stern portion. I have found a single-edged safety razor blade to be useful for such work and also for cutting out the lifeboats, deck units, and cardboard parts. A pair of small-nosed pliers will be necessary for bending the davits.

This clean-cut and workmanlike model is a striking example of what can be done with the simplest materials. The original is only 3 in. longer than the photo

A glance at the list of materials on page 82 shows that only four sizes of wood are needed for the model. A piece of cardboard, thin aluminum, some soft wire, a few common pins, and black, white, blue, buff, and dark and light red paints complete the list.

Begin by sawing out a blank of soft pine for the hull and plane or whittle it to the correct size. Mark the center line all the way around, also the different deck levels. These should be cut in with a fine-toothed saw and smoothed with a file.

Next mark the profile lines of the bow and stern on the blank and cut to these carefully. Be sure to leave thickness enough to take the slot for the rudder. The razor blade will come in handy for this work.

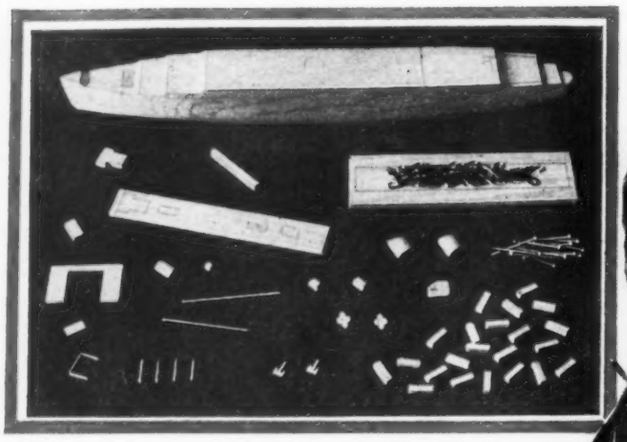
It is best to cut cardboard patterns for marking the top plan lines. The deck levels will not interfere much when doing this. Saw and plane or carve the excess wood away to the lines and round the bottom edges to a radius of about 3/16 in. Your boat will look crude at this stage, but have patience; a little more shaping, and you will be surprised at the result.

Taper the bow end and stern carefully, allowing space enough for the propellers to turn freely. Finish with medium and then fine sandpaper. By using your eyes as well as your hands, you can easily make a hull of true contour, and this will help give the model a neat, craftsmanlike appearance when painted.

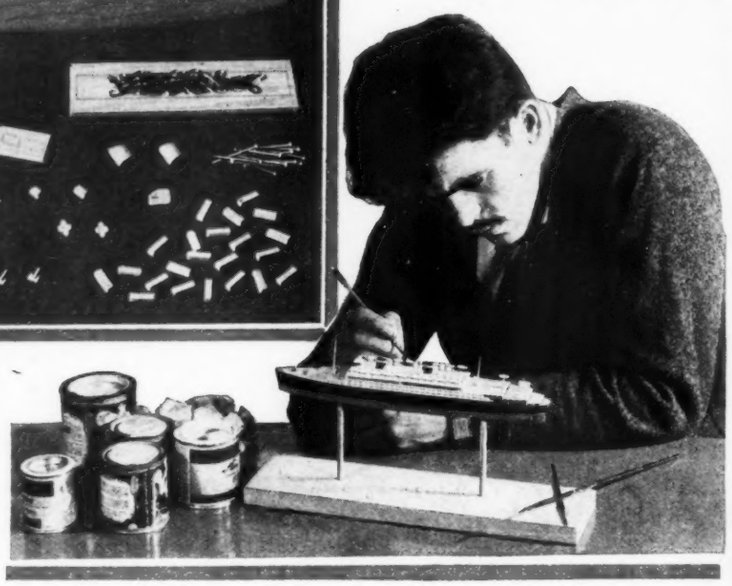
Your next step is to cut out deck unit *B* from 3/16-in. pine. Allow enough extra length to get out the smokestacks, which should be whittled and sanded to shape, then cut to length and beveled. Cut deck unit *C* from 1/8-in. pine and allow enough over to make *F*, *G*, and *J*.

The lifeboats can be cut from 1/8 in. square pine, which can be sliced off the 1/8-in. stock and planed to size. A rule and razor blade will do this job in short order. The bridge *E* and parts *K*, *L*, and *M* are also made of 1/8 in. square stock.

The boats, being so small, may be hard to hold, but they can be shaped easily enough if the work is done slowly and carefully. Cut them all to length with the razor blade and whittle them to shape, finishing with a small piece of sandpaper.



The shaped hull block and other parts in various stages of completion. The wires on the promenade deck are davits

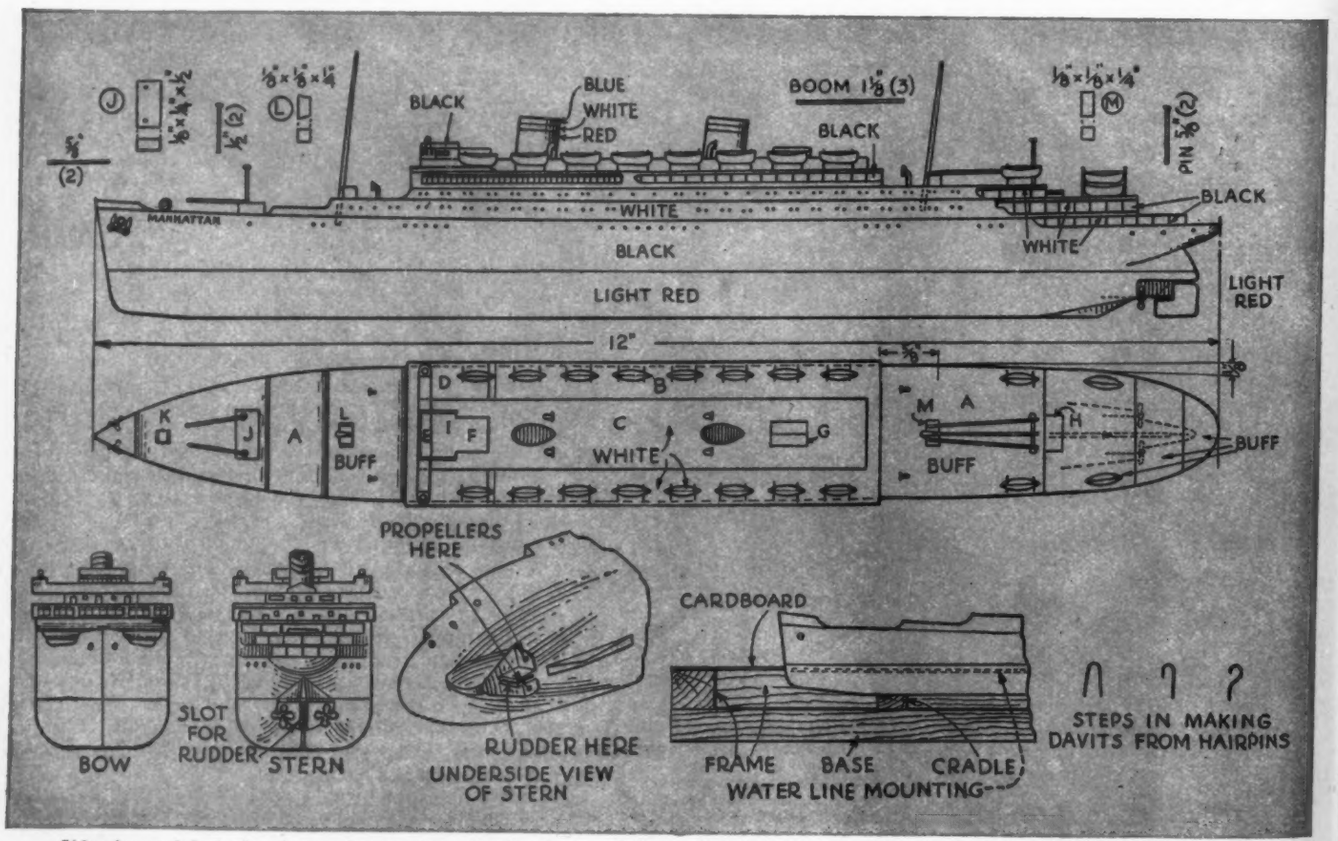


When a model is simplified as greatly as this one, it is necessary to take the utmost care in painting it carefully and realistically

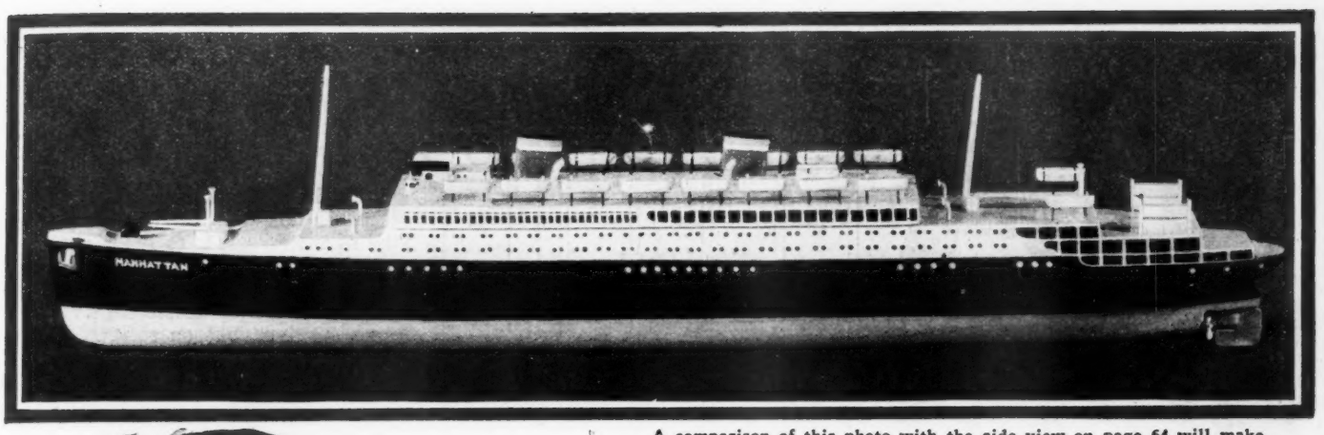
To prevent splitting, the tiny holes for the davits should be drilled first.

Deck unit *D* should be made of cardboard about 1/16 in. thick, and also cut unit *H* of this material. The clay-coated kind will take paint well. Use the razor blade to cut the cardboard to size. These parts should be glued in place with casein glue or any good household cement. All units should be fastened on in the order in which they are lettered: *A*, *B*, *C*, *D*, *E*, and so on. This will save time.

Make the four top deck ventilators of 1/16 in. diameter soft wire. Bend at right angles and then saw off the excess and file to size, holding the wire in a vise, if one is available. The other five ventilators can be made from common pins. Hold the head in the cutting jaws of the pliers but not tight enough to cut them, and bend to a right angle; then cut to length. The derricks and booms also can be made of pins, cemented in place. Make the masts of 3/64 in. diameter soft wire. While the pieces are long, hold them on the bench or worktable and taper them with a file.



Side view and deck plan, bow and stern views, details of some of the small fittings, a perspective sketch of the underside of the stern, the three steps in making davits from hairpins, and a suggestion for a water line base that gives the model the appearance of being afloat

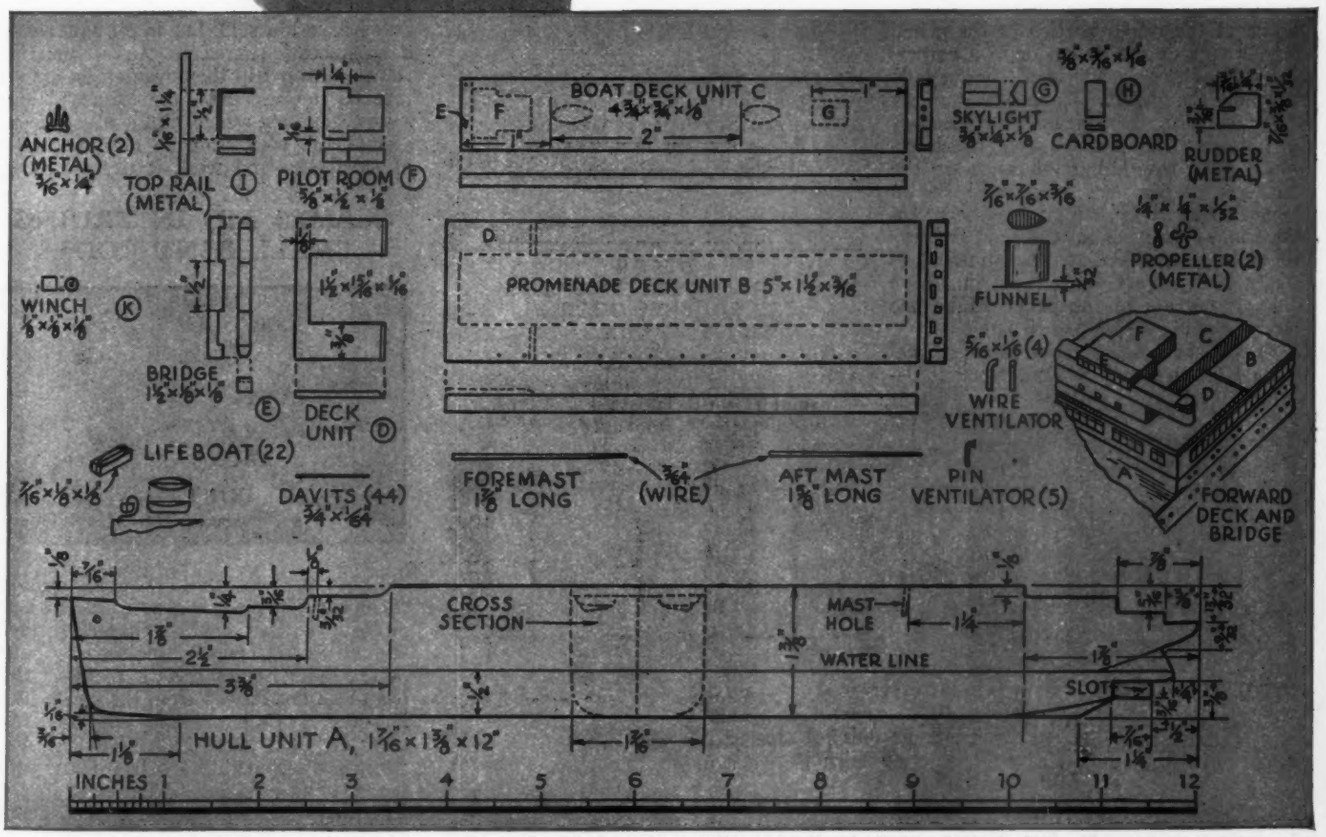


A comparison of this photo with the side view on page 64 will make the construction clearer to those not accustomed to reading drawings

How the afterpart of the model is painted to give the effect of covered decks

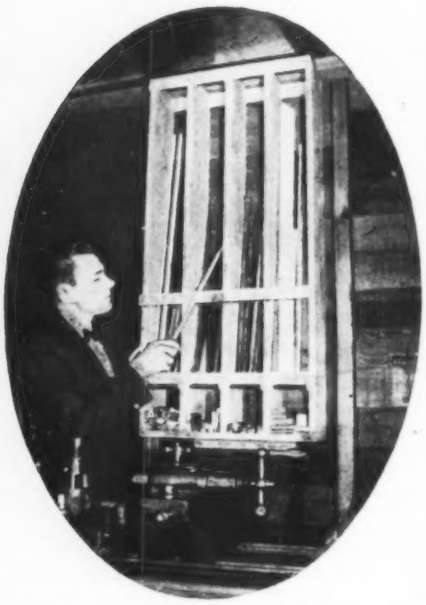
The top rail of the pilot room, the anchors, rudder, and propellers should be cut from thin aluminum or other sheet metal with a jeweler's saw or a fine-toothed coping saw and finished with a file. Polish the anchors with fine emery cloth if they are to be left unpainted. Drill 1/16-in. holes in the bow and push in the ends of the anchors, bending them as shown. A small three-cornered file will be useful for filing between the four propeller blades, but first drill the holes for the shafts.

The lifeboats may be put on either before or after painting the model, as you prefer. Instead of making the davits of No. 24 gage wire, it is somewhat easier to use small hairpins as suggested in one of the detail sketches at the bottom of page 64. The upper curve of the davit is already bent, and all that has to be done is to cut off the hairpin to the proper length and bend the long end as shown. This long end slips into pinholes spaced along the edges of deck unit *B*. It is best to fasten the davits to the boats first and then set them into the holes on unit *B* with small pliers or tweezers. If the boats do not line up, *(Continued on page 82)*


ANCHOR (2) (METAL) 3/16 × 1/4
TOP RAIL (METAL) I
PILOT ROOM F 3/8 × 1/2 × 1/8
BOAT DECK UNIT C 4 3/4 × 3/4 × 1/8
SKYLIGHT 3/8 × 1/4 × 1/8
CARDBOARD
RUDDER (METAL)
WINCH K 1/8 × 1/8 × 1/8
PROMENADE DECK UNIT B 5" × 1 1/2 × 3/16"
FUNNEL
PROPELLER (2) (METAL)
BRIDGE 1 1/2 × 1/8 × 1/8
DECK UNIT D
WIRE VENTILATOR
LIFEBOAT (22)
DAVITS (44) 3/4" × 1/64
FOREMAST 1 1/8" LONG
(WIRE)
AFT MAST 1 1/8" LONG
PIN VENTILATOR (5)
FORWARD DECK AND BRIDGE
CROSS SECTION
MAST HOLE
WATER LINE
SLOT
HULL UNIT A, 1 7/16 × 1 3/8 × 12"
INCHES 1 2 3 4 5 6 7 8 9 10 11 12

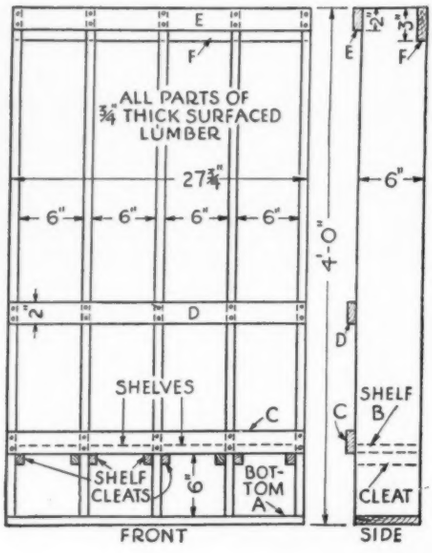
Side view of the hull block alone, with a cross section shown in dotted lines; details of all the other principal units; and an explanatory sketch of the bridge structure. A scale in inches is also given so that any dimensions not expressly stated can be found accurately

Compact Home Workshop Rack Holds Variety of Metal Stock



Metal stock of many sizes and lengths can be kept neatly arranged in this wall rack

THE problem of keeping long and short pieces of unused stock together in the workshop may be solved by a rack like that shown in the accompanying photograph and drawing. Simple and easily constructed, the rack takes up little room and allows a quick choice of any of its contents.



Both the size and number of compartments are determined by the amount and kind of material it is to hold. The lower part from bottom *A* to shelf *B* is for pieces of stock too short to be held in an upright position by crosspiece *D*. Longer pieces stand upright on shelf *B* and are held in place by crosspieces *D* and *E*. The distance between *C* and *D* should be about one quarter of the distance between *C* and *E*.

The rack, which needs no back, is fastened to the wall by means of crosspiece *F*. This is set into the rack divisions as shown in the drawing. If the rack is to hold a heavy load, it may be necessary to fasten a cleat to the wall beneath the rack.—ARTHUR S. CLARK.

RAISED PANELS MADE ON JIG SAW

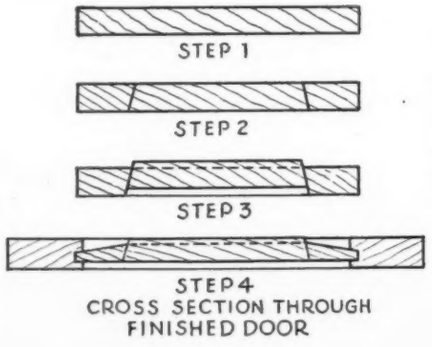
WHEN a shaper is not available, it is possible to make ornamental panels for doors, chests, or other articles on a jig saw, provided it has a tilting table.

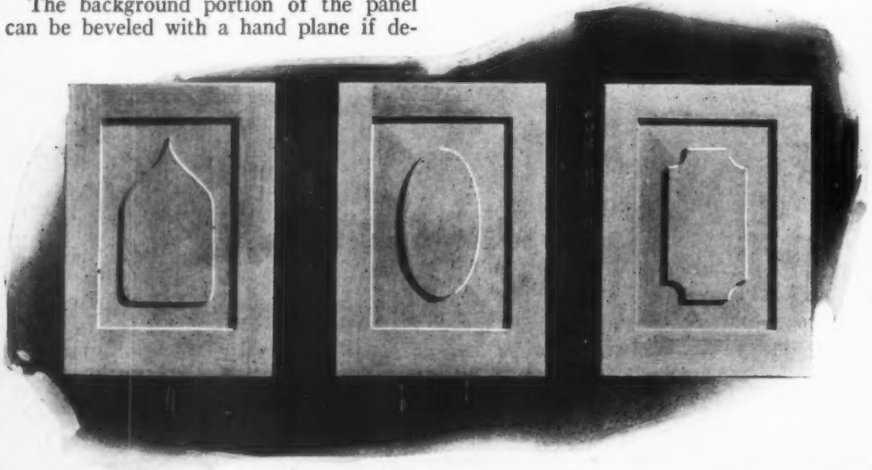
The method is as follows, although the dimensions given, of course, can be changed to suit individual requirements. A ¾-in. piece of wood is selected for the panel and surfaced on one side. Upon this face lay out accurately, in pencil, the design of the raised portion of the panel. At one side of the design or in a corner, if it is one having a corner, drill a hole to admit the jig-saw blade.

The table of the saw must be tilted at the proper angle, which can be determined only by trial. It depends on the thickness of the saw blade and should be such that when the cut has been finished and cleaned of sawdust and the cut-out portion is pushed up through its opening, it will project about 3/16 in. above the low portion of the panel. Make one continuous cut on the pencil line.

The background portion of the panel can be beveled with a hand plane if desired. When this is done, glue the cut-out portion in place and allow the glue to dry. The joint will be perfect.

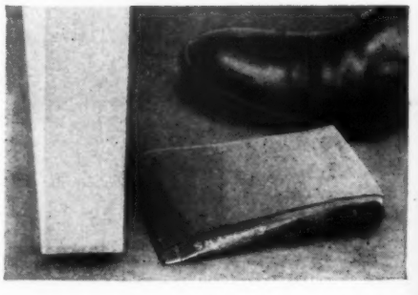
The back of the panel may now be surfaced off so that both parts are flush and the edges are of the proper thickness to fit the grooves in the frame, in this case 5/16 in.—ROGER MOYER.





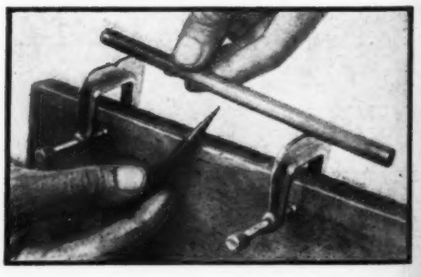
The raised panels of these three doors were made on the jig saw. The panel of the first door has a flat background, but the others are beveled. Each door is 11 by 15 in. over all

DOOR STOP IMPROVISED FROM TOBACCO CAN



SERVICEABLE rubber wedges for holding doors open are sold, but in an emergency a satisfactory substitute can be made as shown above. Rip the cover off an empty tobacco can and press the open end into a slow, tapering wedge. Cut a rubber band about 3 in. wide from an old inner tube of small size and work it over the can.

CLAMPS AID IN TRUING SMALL BENT RODS



ROLLING a piece of round steel or other small straight stock on a flat surface or in V-blocks is a method commonly used to find the high and low points of a bend before straightening the piece. When this has to be done away from the bench, two inexpensive C-clamps may be used. V-nicks are filed in the back of the clamps, which are fastened to any board that happens to be at hand. The piece to be straightened is then rolled in the nicks, and the bend is checked by holding a pencil as illustrated.—W. B.

CHILD'S LAMP HAS NIGHT LIGHT IN BASE

When this unique little nursery lamp is to be used as a night light, only one of its two bulbs is turned on—a small one within the translucent base

Before the comic figures are pasted on the shade, the newspaper on which they are printed is split in two and treated with paraffin

The tobacco jar base and the turned wooden top with the sockets and miniature switch

COLORFUL comic figures, lifted bodily from the "funnies," parade around the shade of this little lamp, which was designed especially for the children's room. In addition to the novel shade, there is a small bulb hidden in the translucent base, and this serves as a subdued night light when the main bulb is switched off.

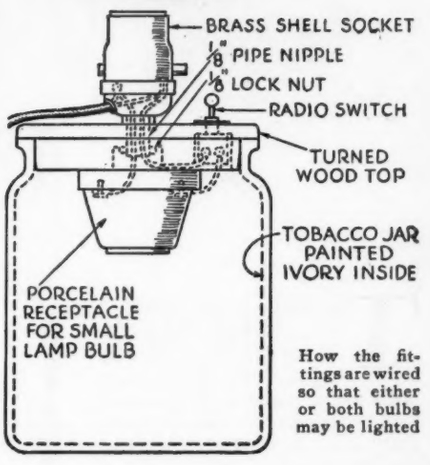
Since the originality of the lamp lies mainly in the process that makes possible the use of the comic supplement figures, the shade will be described first. Its foundation may be any plain white or cream parchment or stretched silk shade. The one shown cost 20 cents.

As the comics are printed on both sides, the paper must be split and made translucent. To do this, cut from a colored supplement a number of rectangles containing the figures desired. Coat each one thoroughly on both sides with a good grade of paste, and place a piece of white cotton cloth on each side. Rub well all over to insure the cloth's sticking to the paper, and put aside to dry. The two pieces of cloth may then be carefully pulled apart, and one side of the paper will be found sticking to each. Any difficulty encountered in doing this will be due to the fact that the cloth has not been thoroughly pasted to the paper.

After splitting the paper, soak it in warm water until it can be removed from the cloth, and spread it face down on a blotter to dry. Next, dip the pieces in melted paraffin and iron out the surplus paraffin with a hot iron on a blotter or a piece of cardboard.

The figures should now be cut out carefully along their outline. A little girl of the paper-doll age can do this nicely. The prepared figures are then pasted in the desired order around the shade. A thin coat of shellac completes the shade.

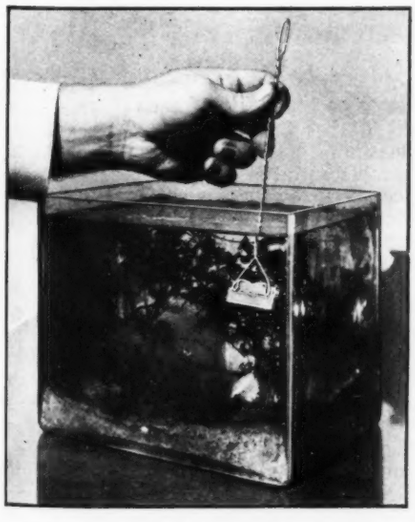
The base of the lamp is a one-pound glass tobacco jar, evenly coated on the inside with white or ivory paint. Pour a little thin paint in the jar, roll it until the surface is all covered, and stand the jar upside down on a couple of sticks to drain. If desired, figures like those on the shade may be pasted around the base.



How the fittings are wired so that either or both bulbs may be lighted

The top is turned from any available wood to fit the jar. The method of mounting the sockets and switch is shown in the drawing. The small switch controlling the lamp in the base is a miniature switch of the type used on radio panels. The wiring allows either the base or upper light alone, or both together, to be used. After wiring, paint or enamel the wooden top to match the base.—LEE M. KLINEFELTER.

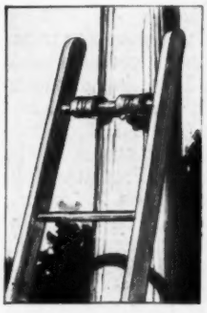
SCRAPING AQUARIUM WALLS CLEAN



A RAZOR blade does a good job of scraping the unsightly green growth from the walls of an aquarium, but ordinary holders are too short and clumsy for this use. It is better to make a simple bent-wire holder for the razor blade like that illustrated, because it will let you do the job with the least possible disturbance to the fish. Besides, the wire handle can be made any length necessary to reach to the bottom of the aquarium. The ordinary galvanized wire sold on small spools is sufficiently strong if the handle portion is twisted as shown.—A. P. L.

Scraping the walls of an aquarium with a razor blade. The clamping end of the wire holder is bent as shown in the drawing

SAFER WAY OF SETTING LADDER AGAINST POLE



Inner tubes wrapped around the top rung to prevent slipping

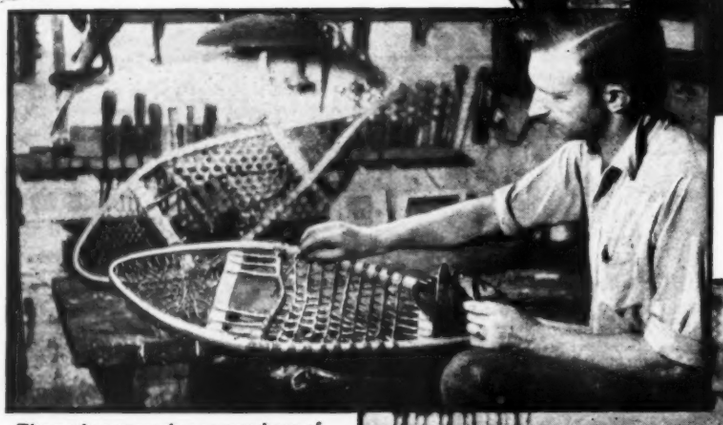
IT IS not safe to rest the top rung of a ladder against a tall pole or post, yet there are times when it must be done. To make it less hazardous, wrap strips of an old inner tube about the rung as shown at the left and tie or wire them tightly in place. There should be a 2- or 3-in. space between them so that the rung itself will be in contact with the pole. The rubber bindings, if tight enough, will prevent the ladder from slipping sideways.—F. W. BENTLEY, JR.

"Snowshoe Making *Is Easy*"

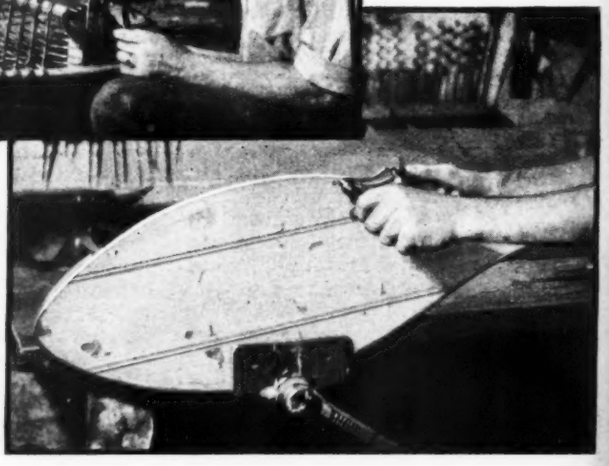
says

LEONARD F. MERRILL

Expert woodsman and Maine guide



The author at work on snowshoes of the type he uses when guiding hunting parties in the Maine woods. The standard shoe is about 14 by 45 in. and has a tail from 6 to 7 in. long



Shaping the rough wooden form around which the bows are bent. The woodwork is not difficult to do, but applying the filling requires care if your shoes are to have a professional look. Send a stamped envelope for a Home Workshop bulletin on the filling

For steaming the snowshoe bows, a long box is made from any scrap lumber. A hole is bored in one of the end pieces to receive the hose which carries into it steam from a kettle of boiling water

THERE is no truth in the old idea that snowshoes can be made only by an expert. Anyone with a fair amount of patience can undertake the work successfully if he follows step by step the simplified directions given below.

The standard Maine model shoe with a tail 6 or 7 in. long is the one that meets the requirements of the largest number of people. As the average man who goes in for outdoor sports weighs about 175 lb., a 14 by 45 in. shoe will be described. A table of sizes for other weights is also given so that you can substitute your own dimensions if necessary.

Material for Bows. Straight grained ash or second growth hickory—1 pc. 1 by 2 in. by 8 ft. 4 in. and (for crosspieces) 1 pc. ½ by 3 in. by 2 ft.

Template. Fold sheet of wrapping paper 15 by 36 in. lengthwise in center. Mark points on fold at the following distances from one end: 7, 8½, 13, 23, 24½, and 35 in. Number these points 1, 2, 3, and so on. Draw lines at right angles to the fold through these points. From the fold measure on line 1, 5¼ in.; on 2, 5¾ in.; on 3, 6¼ in.; on 4, 4 in.; on 5, 3⅜ in. On line 6 make no measurement, for this is the point where the bow ends come together. Draw a smooth curve through these points. Cut out and unfold template.

Bending Form. Use scrap wood at least ¾ in. thick. Trace template on wood and cut to line.

Bows. Rip the 1 by 2 in. by 8 ft. 4 in. piece into two pieces 1 by 1 in. by 8 ft. 4 in., and dress each to ¾ by ¾ in. by 8 ft. 4 in. Mark the top and bottom of each piece on the edge grain, keeping the flat grain for the inside and outside. On the top (see diagram) draw a center line and lay off a space 11 in. each side of it. From the inside edge measure out on the center line ⅜ in. and connect to the outside at the 11-in. marks. Draw cross lines 10 in. from each end and connect the inside ends to points ½ in. in from the outside on the end. Dress to these lines.

If the toe is to be bent up a little, the underside or bottom will have to be thinned slightly. Do not make the toe less than ⅝ in. thick at the very center, and cut away not more than 10 in. each side of the center.

Lay out mortise holes for the crosspieces on the inside of each piece. From the center, measure 10½ and 11⅝ in. and draw lines as shown; from the second line, measure 15½ and 16⅝ in. and draw lines. Repeat on other side of center line. Mortises are ¼ in. wide and ⅜ in. deep, and placed in the center of the thickness of the piece. Trim off all sharp edges.

Steam Box. Inside measurements, 2 by 2 in. by 8 ft. 5 in.; made of any kind of wood nailed together and with one end left off so that the bow can be put in. Bore a hole in the loose end large enough to fit a short length of garden hose. The nails in the end should be left projecting so they can be pulled out the second time you use the box.

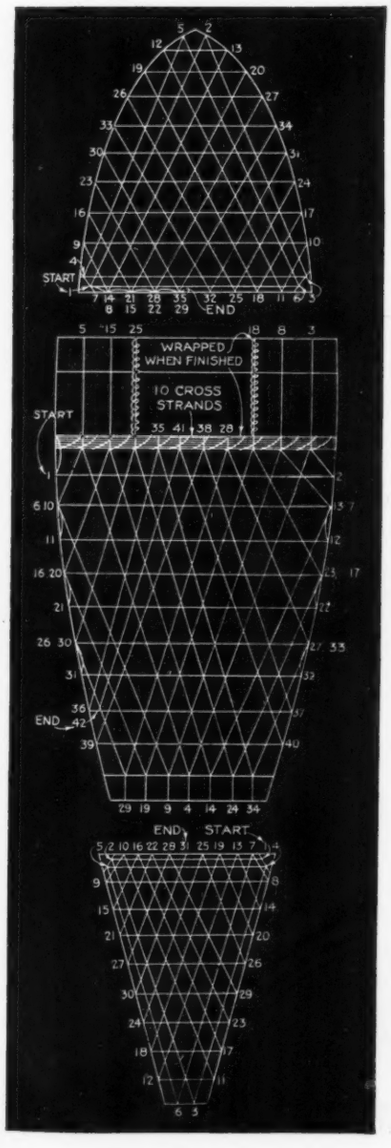
Steaming. Fit the rubber hose over the

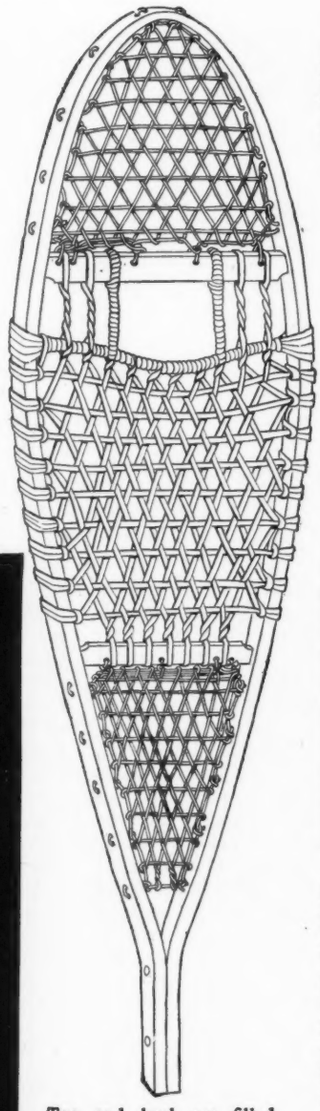
spout of a large teakettle and in the hole in the box end. Steam from 15 to 25 minutes, replenishing the water as necessary to maintain a good flow.

Bending. Start the bend at the toe and bend gently but quickly around the form. Clamp the ends together; then work the bow down by taking up the slack and holding with another clamp until the bow is snug around the form. Dry from 24 to 36 hours.

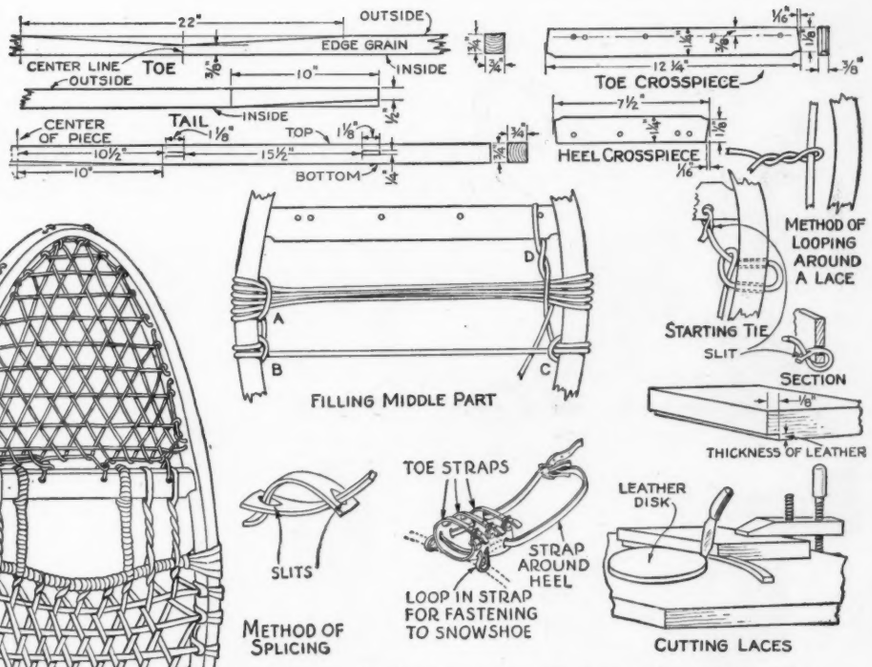
Riveting must be done before removing the clamps. Drill a hole 1 in. from the end and insert a 1⅛ in. long rivet. Put a washer on rivet before heading over. A second rivet is put in 5 in. from the first, but is headed on the opposite side. Remove bow from form.

Crosspieces. Rip the ½ by 3 in. by 2 ft. piece in two and dress each piece to ⅜ by 1¼ in. by 2 ft. The toe pieces are cut 12¼ in. long, tapered on the ends 1/16 in. toward the front; the heels are 7½ in. long, beveled 1/16 in. toward the heel. The top and bottom are tapered to ¼ in. or to fit the mortises. On the longer edges taper the ends until they fit the mortises. Leave the front of the toe and the back of the heel piece straight.





Toe and heel are filled with ⅛ in. wide rawhide, the middle part with ¼ in. wide strips. The numbers on the diagram at left show how the strips are taken from point to point



Diagrams showing how to shape the bows and crosspieces, how to cut, tie, and loop the laces, and how to make the foot harness

TABLE OF SIZES FOR MAKING SNOWSHOES

Weight to support	Length of shoe	Width of shoe	Toe cross-piece	Heel cross-piece	Suitable for use by
125	42	12	9	6	Boys and girls
145	42	13	9½	7	Older boys and young women
160	45	13	10	7	Men and women
175	45	14	11½	7	Men and women
190	45	15	10	9	Men
200	48	15	11½	9½	Men

Draw lines ⅜ in. from the straight edges and parallel to them. On the toe pieces measure from the left end 1¼, 1¾, 4¾, 8, and 11¼ in. and drill 3/16-in. holes at these points. The heel measurements are 1, 3¼, 6, and 6½ in. from the left end.

Assembly. Sets of 3/16-in. holes are drilled in pairs ½ in. apart through the bow from the outside at both toe and heel. Measure ¾ in. each side of center of toe and drill two sets. At a point 1 in. from the toe crosspiece, drill another set. Divide the remaining distance into four equal parts and drill three more sets. Do the same on the other side of the toe.

The first heel set is drilled ¾ in. back from the crosspiece. The distance from these holes to the point where the bow comes together is divided into four equal parts and three more sets drilled.

These holes are to receive the starting lace, which is tied at each pair as shown in the detail marked "starting tie." The filling laces are looped around this lace and do not pass through the holes.

Set the crosspieces into the mortises.

Final Bending. Make a form of scrap wood large enough to cover the whole toe section of the shoe. This can be made of three ¾ in. thick pieces nailed together so that the bottom piece projects at least 2 in. beyond the others. Plane a curve on the toppieces starting from 4 to 4½ in. from the end; this should correspond to the upward bend the toe is to take.

Clamp the bow upside down on top of the form. If one jaw of a clamp is placed under the projection of the bottom piece and the other on top of the toe center, the desired curve can be bent. The steaming is done by placing the toe in a tub of hot water and boiling for 15 or 20 minutes.

When the wood is dry, sandpaper it and apply a coat of shellac.

The three sections of the shoes—toe, middle, and heel—are filled separately with rawhide.

The harness for fastening the shoe to the foot can be made of any soft but tough leather, or it may be bought from any large sporting goods dealer.

A long step-by-step explanation of how to apply the filling will be sent free to any reader who incloses a self-addressed and stamped envelope. Ask for Home Workshop Bulletin No. 14.

A Tiny Hidden Pump Throws Glittering Jets

Ornamental Indoor

In the base of this modern looking monel metal fountain is concealed a small pump and motor. No water connection is needed

THIS decorative, self-contained electric fountain uses the same water over and over. It is intended primarily for use in a sun room or on an inclosed porch, but, being portable, it may be placed wherever suitable electric connections are available. Set up in a store window surrounded by potted plants, it will prove a never-failing source of attraction. It makes a beautiful centerpiece, too, for a large dining room table.

When set up it runs for hours without attention and is so silent that the slight hum of the motor is practically drowned by the pleasant tinkle of the water. If the fountain is constructed with reasonable care, it should not leak a drop, even after long continued use.

The small centrifugal pump and the motor are flexibly connected by means of a short length of rubber hose taken from an old foot pump. They are mounted on wooden blocks that rest on a piece of sponge rubber kneeling pad. Two flathead wood screws secure the principal base block to the bottom of the fountain base as shown in the drawings. A sliding door forms one of the eight sides of the base so that the motor and pump may be oiled or adjusted. Flexible rubber hose leads the water from the inlet to the pump and from the pump to the fountain jet. There is no direct metallic connection between the basin of the fountain and the motor pump, and the water lying in the basin effectively deadens any vibrations.

The small but efficient centrifugal pump is less than 3 in. in diameter. It is machined from gunmetal castings, and the shaft is of rustless steel. This type of pump may be obtained in finished form ready for use, or the various parts may be purchased machined ready for assembly, or complete sets of castings and parts together with blueprints may be had quite reasonably. Anyone who enjoys making models and who understands the use of a small engine lathe will find it comparatively easy to make the pump from castings, which is what the writer did.

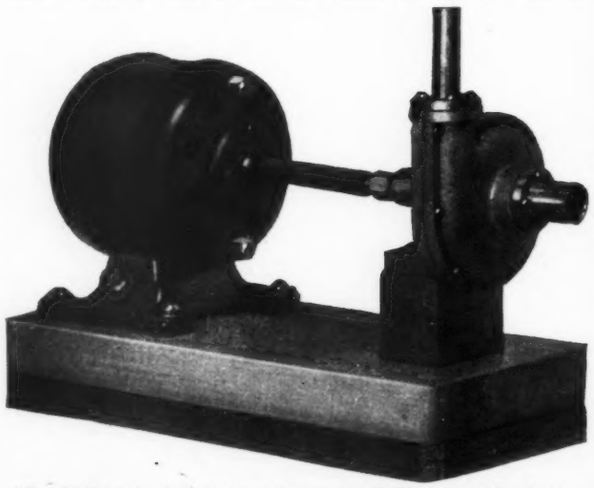
With the motor running at top speed, the pump will throw three jets of water from 8 to 10 ft. high, each jet being 1/16 in. in diameter, or it will throw twenty-five 1/16 in. diameter jets from 12 to 24 in. high, the height of the jets being controlled to avoid drops splashing outside the basin. Jets from 8 to about 18 in. high are suitable for the diameter of the basin shown. The higher the jets, the larger the fountain basin must be.

The motor used is a battery motor made by one of the best manufacturers of such products. A toy train transformer connected to the house lighting circuit furnishes the current. The advantage of this combination is that the tapped transformer allows various motor speeds so that the height of the jets may be controlled. A small A. C. motor may be connected directly to the pump and run without any transformer, if preferred. It is also possible to adapt very small fan motors to run the pump, the large base or standard being removed and the shaft connected directly to the pump with the flexible hose coupling. Small toy battery motors of an inexpensive type, however, are not suitable since they are not designed for continuous running and usually are far from silent.

Whatever motor you decide to use, be sure that it has good bronze bearings and that the armature is well balanced to run with little or no vibration. The pump requires very little power so that the smallest sizes of motors commonly sold, provided they are of the better grade, are suitable for a fountain as small as that shown.

The base and basin preferably should be made of some nonrusting metal of No. 24 or 26 B. & S. gage—copper, brass, monel metal, or possibly one of the new rustless steels. Any of these may be soldered with soft solder. The fountain illustrated is of monel metal. As may be seen from the drawings, the entire structure, except for the bottom of the basin, is made from comparatively small pieces to facilitate construction in the home shop. Methods of folding over the edges and doing the other operations have been previously described (P.S.M., Apr. '30, p. 81, and June '31, p. 116).

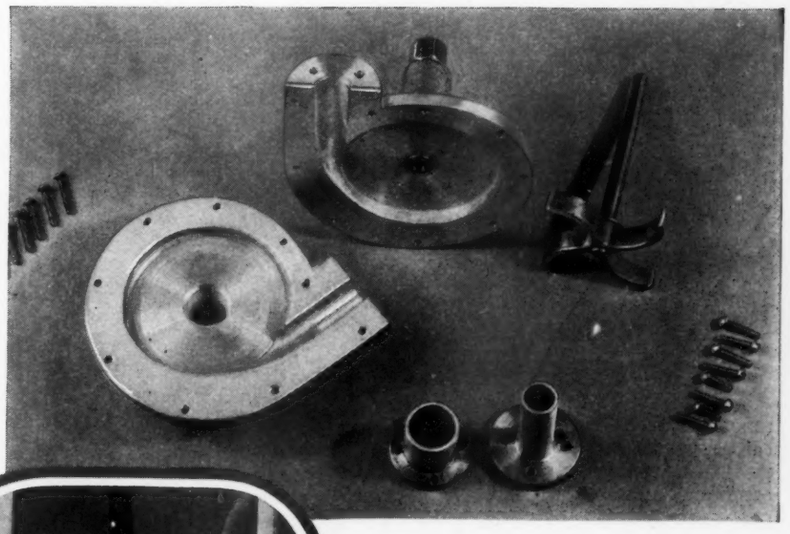
The only new operation involved is that of turning the upper edge of the basin outward and over a thick wire to form a rounded edge. This is done with a wooden forming mallet as shown in the drawings. The wire, which should be about 3/16 in.

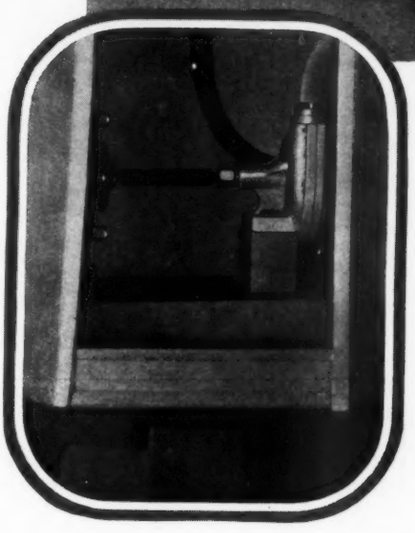


The flexibly coupled motor and pump are fixed on a wooden baseboard, which, in turn, is set on a sponge rubber kneeling pad

# of Water from This Fountain

By EDWARD THATCHER





Looking through the door in the base of the fountain and, above, the parts of the pump

thick, is bent to fit around the edge of the basin in an eight-sided shape before being applied. The two ends meet in the center under one of the rounded-over edges. This wire preferably should be of the same metal as the fountain.

First assemble motor and pump on the wooden base block as compactly as possible with the motor and pump shafts exactly in line. The flexible coupling should not be too short and should fit the shafts very tightly or be cemented on. When this assembly is completed, test it to see that it works satisfactorily, making temporary hose connections to the pump and using a large tin can as a reservoir.

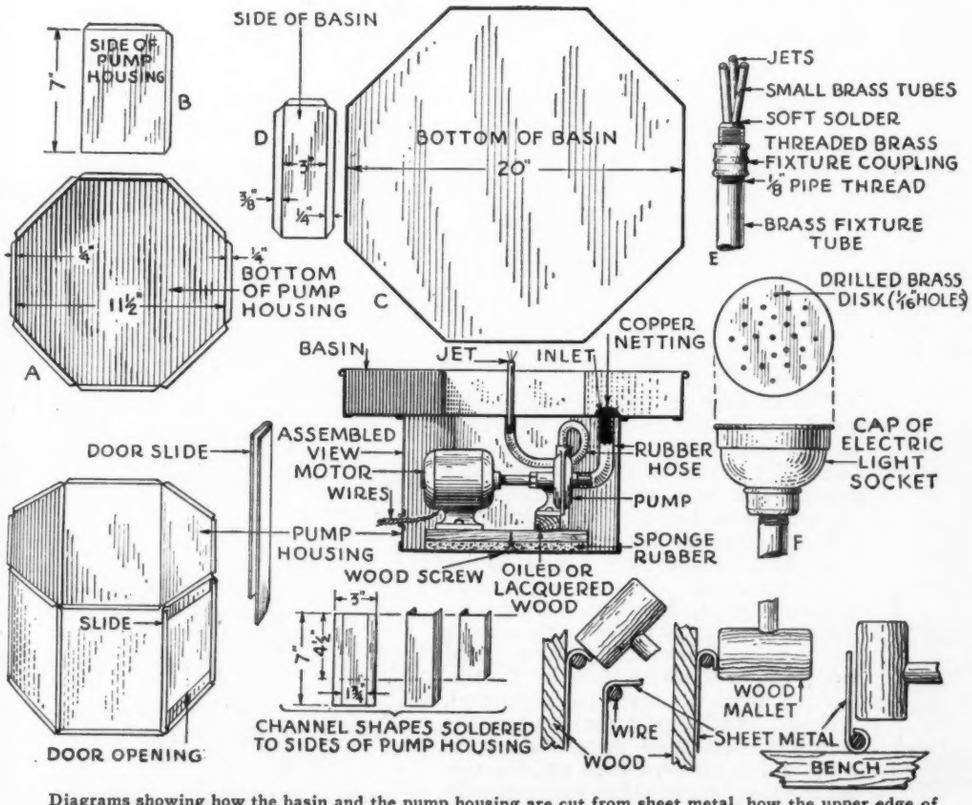
Next build the pump housing. Turn up the flaps at the edge of bottom *A* over a wooden block, unless you prefer to cut all the parts for the housing and basin and take them to your tinsmith to have them folded on his bar folder. Next cut the seven sidepieces *B*. The eighth side is used as a door and has folded strips of tin soldered across the top and bottom as shown. A folded strip is soldered to the housing of each side of this door to form slides. Solder the parts together, adding one side at a time. Use a very heavy soldering copper, well tinned and heated. The flap on one side of each piece *B* laps over the edge of the next piece when soldered in place. All soldering may be done on the inside of both housing and basin except in joining the basin to the housing.

Two holes should be punched in the bottom of the housing for the two screws which pass up through the sponge rubber into the block holding motor and pump.

The bottom *C* of the basin is one flat eight-sided piece of sheet metal, to which the eight folded pieces *D* are soldered. The wire is put in the upper edge after the basin is soldered. A close-fitting hole should be made in the center of the fountain for the jet pipe, and another suitably located for the inlet pipe to the pump. The pipes are soldered in place after the basin is soldered to the pump housing, and a small disk of copper mosquito netting is soldered over the inlet pipe. The soft rubber hose connecting the pump to the jet and inlet should fit tightly.

The upper end of the jet pipe should be threaded with ⅛-in. pipe threads so that different types of nozzles may be tried and the most desirable chosen. One-, two-, or three-jet nozzles may be made by soldering short lengths of brass or copper tubing of about 1/16 in. inside diameter in the end of one of the threaded brass couplings used in electric light fixtures as shown at *E*. These couplings, together with short threaded lengths of threaded brass tube, are obtainable wherever electrical fittings are sold. A spray head also may be made from the cap of an electric light socket with a drilled disk of metal soldered over it as shown at *F*. As this is also threaded with ⅛-in. pipe threads, it will fit the jet pipe.

Another variation would be a single jet thrown straight up so as to keep a celluloid ball tossing in the air. In that case, a small wire basket should be soldered to the pipe to catch the ball when the fountain is turned off.



Diagrams showing how the basin and the pump housing are cut from sheet metal, how the upper edge of the basin is turned over a thick wire, how the pump and motor are mounted, and how the jets are made

Short Cuts for Car Owners

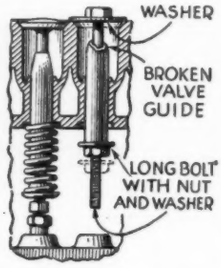
Clever Ideas Contributed by Our Readers Will Make Many Hard Auto Jobs Easy

GARAGE doors having independent floor and ceiling catches can be opened with one hand if they are equipped with the simple lever arrangement illustrated. The handle, which can be shaped from a ¾ by 2 by 12 in. piece of wood, is pivoted on a heavy screw driven into the door and is connected by means of strong wires to the two bolt catches. The hole for the pivot should be drilled slightly larger than the screw. A downward pull of the conveniently placed lever releases both bolts simultaneously and eliminates all the "reaching up and stooping down" that is generally necessary to disengage the separate catches.—E. H.

Simple lever opens two garage door catches at once

Broken Valve Guide

NOW and then when doing a valve job on a car, a valve guide will break off a short distance below the top. On cars having the particular valve arrangement shown, the portion that remains in the engine block can be removed with a bolt, nut, and two washers. The bolt, with a washer larger than the valve opening under its head, is dropped down through the guide. Then the second washer is slipped over the lower end of the bolt and the nut screwed into place. Tightening the nut slowly forces the valve guide upward so that it can be removed easily with the fingers.—J. M.



Bolt, nut, and washers used to remove broken valve guide

Battery Clip Improves Your Extension Light

Battery connection clip attached to the top of the wire guard on an extension light, enables you to fasten the lamp at any angle

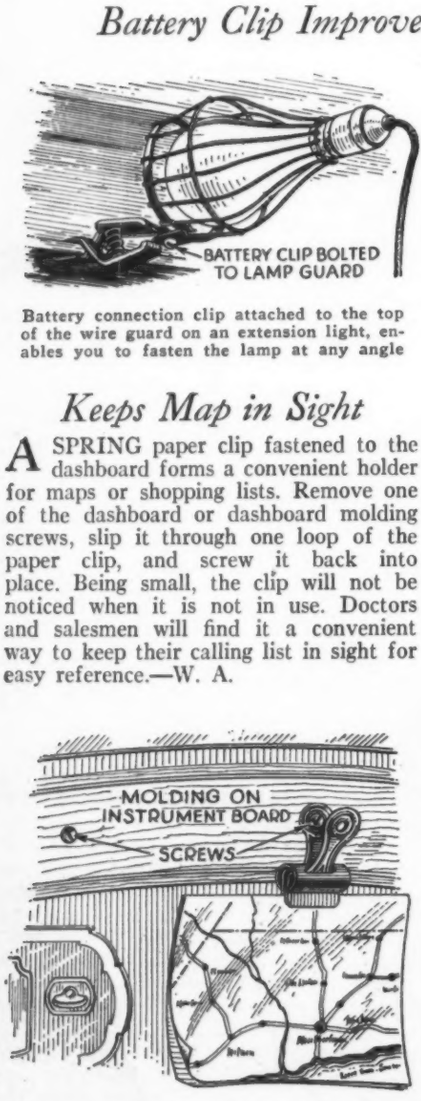
WHEN working under a car, a good extension light is an indispensible part of the repair kit. In most cases, the bulb is fitted with a wire guard having a convenient hook for suspending the lamp from convenient projections. A lamp of this type while handy, can be greatly improved, however, by the addition of an ordinary battery connection clip. The clip is attached to the top of the wire guard and makes it possible to fasten the lamp anywhere and at any angle that you may desire.—E. L.

Running Board Repair

MANY cars are now provided with sturdy metal running boards covered with rubber matting. If for some reason, the rubber becomes cut, ripped, or worn a complete replacement is usually in order. However, a good repair can be made with tire cut filling compound. The damaged spot is first scraped and then washed with gasoline. When it is clean, a thick coat of the rubbery paste is applied. Since compounds of this type tend to shrink slightly several applications may be required to make the patch.—C. M.

Keeps Map in Sight

A SPRING paper clip fastened to the dashboard forms a convenient holder for maps or shopping lists. Remove one of the dashboard or dashboard molding screws, slip it through one loop of the paper clip, and screw it back into place. Being small, the clip will not be noticed when it is not in use. Doctors and salesmen will find it a convenient way to keep their calling list in sight for easy reference.—W. A.



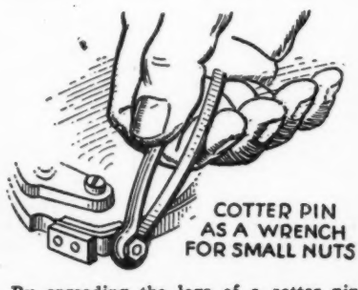
Clip fastened to dashboard will hold road map

Finding Valve Tap

HIT or miss judgment in locating a valve tap can be replaced by a simple test made with squares of thin cardboard. Cut the covers from several paper match books into one-inch squares and slip one square between each valve stem and its corresponding tappet or arm. Then start the motor and allow it to run at idling speed. With the cardboard squares in place, the valves will be comparatively quiet. By removing the squares one at a time, however, a poorly adjusted valve will soon reveal itself by its telltale tap. When a noisy valve is detected, it should be adjusted before the next one is tested. Any noise present when the cardboard is removed from under a tappet can then be credited to that particular valve.—E. M.

Cotter Pin Wrench

HAVING no wrench suitable for the small nuts found on many distributors, the amateur mechanic will find that a large cotter pin can be made to serve the purpose. By spreading the legs of the cotter pin, the eye can be slipped over the sides of the nut. Pressing the legs together will contract the eye and grip the nut, allowing easy adjustment.—R. A.



By spreading the legs of a cotter pin, its head can be used to unscrew distributor nuts

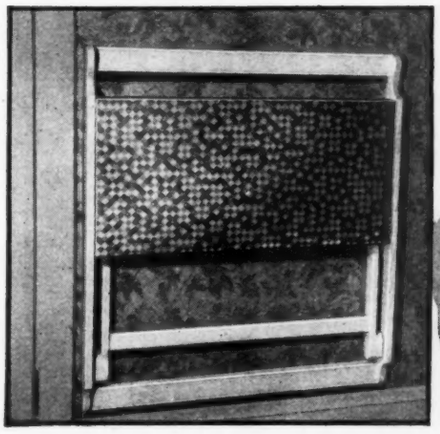
KITCHEN WORKTABLE FOLDS FLAT AGAINST WALL

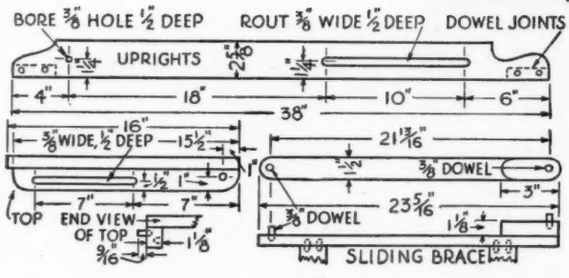
WHERE space is at a premium and a table is needed, whether in the small kitchen, kitchenette, shop, or boat cabin, a folding table like that illustrated will fill the need. This table, when lowered into position, is absolutely rigid, yet its construction is simple. It works perfectly and has one great advantage over many tables of this type in that it cannot slip while in use.

The dimensions are given in the drawings, except the length, which is governed by the size of the top required. The one shown has a top 16 by 32 in., made from ¾-in. stock. Inlaid linoleum is cemented to the top with waterproof casein glue.

In constructing the framework, the dimensions for the various parts must be closely followed, and before assembly they should be tested so that all slides and pivots work loosely. The parts should be finished before assembly, the finish depending upon the purpose for which the table is to be used and the surrounding furnishings.

The unit should be fastened to the wall so that the top, in its lowered position, is from 30 to 32 in. from the floor, unless it is intended for some special purpose which requires it to be higher or lower. When used only as a worktable, it pays to have it fairly high.—JOHN M. CHITTENDEN.





This folding table is especially useful in a kitchenette, in the cabin of a small boat, or in any other restricted place

At the left are dimensioned drawings of all parts but the top, which is 16 in. wide and of any reasonable length

ATTACHING RUBBER TUBE TO ORDINARY FAUCET

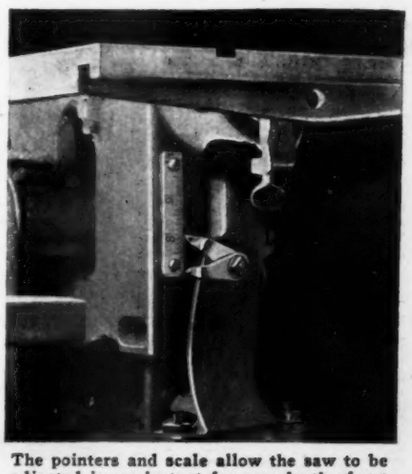
THE home photographer or experimenter will find many uses for a small rubber tube that can be connected and disconnected quickly and easily from a standard faucet. It is convenient for filling and washing small bottles and for filling trays. Take a common rubber bottle cap of the type illustrated below and cut out the central core down to the bottom. Remove the eraser ferrule from an ordinary lead pencil, push out the rubber and the bit of wood left in it, and insert half the ferrule into the tubing and the other half into a hole made in the center of the cap. A piece of brass or glass tubing may be used in place of the ferrule. Push the cap snugly and tightly over the threads of the faucet as shown.—F. B.

A common rubber bottle cap is used to connect the small size tubing with the faucet

DEPTH GAGE FOR SMALL CIRCULAR SAW

IT IS comparatively easy to calibrate most small circular saws for depth of cut by following the method illustrated at the end of this article. From an old rule cut a 3½-in. piece, and drill it for screws. Drill and tap either the moving or the fixed part of the saw base, depending on which is more convenient, and attach the scale with machine screws. Cut two pointers from sheet iron 1/16 in. thick, bend them as necessary, and attach them to the other base member with a single screw.

To locate the zero position, lower the saw until, when turned by hand, it just scratches a board laid on the table. Set one pointer at the end of the scale. Set the other pointer similarly to correspond to the shorter radius of the dado saw. Clamp the pointers tightly, and readjust, if necessary, by tapping them with a hammer. The pointers are easily readjusted from time to time to compensate for the reduction in diameter of the saws caused by filing.—EDWIN M. LOVE.



The pointers and scale allow the saw to be adjusted in an instant for any depth of cut

MAKE USE OF OUR

Blueprint Service

WHAT are you going to build next in your home workshop? Whatever it is, look first at the list of Popular Science Monthly blueprints on page 94 to see if the subject is mentioned there. If it is, it will pay you to obtain the blueprint or blueprints. They contain tested designs and have been used successfully by thousands of other readers, and they will go far toward insuring your success.

You will also find the list useful for suggesting projects when you are in doubt as to what to construct next.

A more complete list is given in our blueprint folder, which contains a brief description of all the projects. It can be had for the asking, provided you inclose a self-addressed and stamped envelope.

Reprints of our best model making articles are also available for 25 cents each. They are indicated on the blueprint list by the letter "R."

Photo Problems

and how to solve them by FLASHLIGHT

By FREDERICK D. RYDER, JR.

Pictures like this, almost impossible to take by daylight, are easy if a photoflash lamp is used to light the interior

"HINDSIGHT," remarked a beginner at photography in disgust, "is a lot clearer than foresight in this picture taking game. I shoot a roll of film and when I look over the prints, I can see with half an eye all the things I should have done before I pressed the button."

"That's nothing to worry about," I told him. "Picking flaws in your own pictures and studying what you should have done to make them better is a sure sign that you are going to improve."

If you are a beginner, remember, too, that a bit of uncertainty as to whether results will come up to expectations is one of the fascinations of the game, adding to the zest.

Of course, if your photography is confined to outdoor snapshots, your chief worry will be the matter of proper exposure. Indoors, the problem of correct timing can be eliminated by using flashlight. With the photoflash lamp, for instance, you can be certain that your film will receive exactly the right amount of light every time.

In previous articles, I have discussed the unique advantages of the photoflash for taking pictures of babies, children, and animal pets. In this field it has no rival. Most amateur photographers do not realize that the photoflash is, in some ways, better than any other source of light even for the portraiture of grown-ups, interior views, and various still life subjects.

Suppose, for example, you wish to take a picture such as the one on this page. This little domestic scene looks perfectly natural and appears in the picture just about as the eye would see it. Through the window the house and tree on the opposite side of the street are clearly visible, yet objects inside the room also stand out. The human eye sees the actual scene this way because it has an astounding capacity for registering extremes of light and shade—far beyond that of any photographic films or plates.

Try this picture with nothing but daylight for illumination and no matter how you juggle the exposure, either the window will appear as a blank white rectangle or else everything inside the room will be as black as pitch.

The solution is a photoflash lamp touched off to light the interior while daylight registers the scene through the window. Of course, the shutter should be open only long enough to touch off the flash, otherwise the view through the window will be overexposed. It is best to try shots like this on cloudy days unless you are expert at handling the shutter and photoflash release button or you have a synchronizing device.

In ordinary interior views that include windows, it is common practice, when daylight is the only source of light, to make ninety-five percent of the correct exposure with the dark shades drawn and then open the shutter again for the remaining five percent after the shades have been run up.

Experts can do beautiful work this way, but it takes experience in judging light values. The amateur will be much more certain of good results in taking interior views if he uses a photoflash lamp or two to get the shot. Forget that sunlight is

$100 in CASH for Family Group Photographs

A FIRST prize of $50 and five other cash awards, amounting to $100 in all, are offered by POPULAR SCIENCE MONTHLY for the best family group photographs taken indoors. The pictures will be judged on their photographic qualities, the general arrangement, the lighting, and the naturalness with which the group is posed.

All the old difficulties of taking group pictures in the house have been overcome by the introduction of photoflash bulbs, which make no noise, dust, or smoke, involve no fire risk, and do not startle those who are being photographed. The contest is intended primarily to encourage you to learn to use this method, but daylight or other illumination may be used.

The developing and printing may be done by a professional, but the picture must be taken by an amateur during the months of January and February, 1933. Mail both print and negative to the Photographic Editor, POPULAR SCIENCE MONTHLY, 381 Fourth Avenue, New York, not later than March 1, 1933, and mark your entry "February Photo Contest." Also write on the back of the print whether daylight or artificial light was used, and if flashlight, which type.

You may enter several photos. If you wish the negatives returned, inclose a self-addressed and stamped envelope for this purpose. The contest is open to all except employees of POPULAR SCIENCE MONTHLY and their families. In case of ties, each tying contestant will be awarded the full amount of the prize tied for.

FIRST AWARD	$50
SECOND AWARD	25
THIRD AWARD	10
FOURTH, FIFTH, and SIXTH AWARDS, $5 each	15
TOTAL	$100

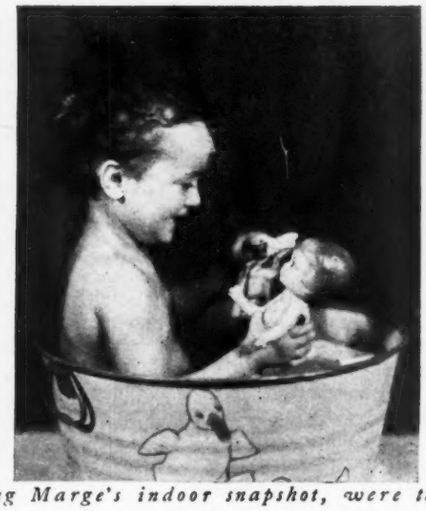
How an advertisement brought Marge
TWICE AS MUCH FUN WITH HER CAMERA

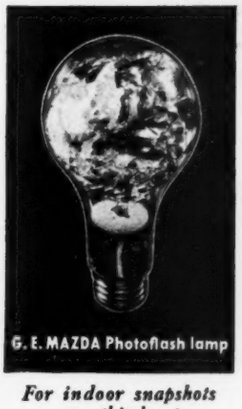
JEAN, LOOK AT THIS. IT SAYS THAT THESE G.E. MAZDA PHOTOFLASH LAMPS MAKE IT AS EASY TO TAKE SNAPSHOTS IN THE HOUSE AS OUTDOORS. DO YOU KNOW ANYTHING ABOUT THEM?

I CERTAINLY DO. HERE'S ONE OF THEM. JACK KEEPS THEM ON HAND ALL THE TIME, AND MARGE, THEY'RE SIMPLY MARVELOUS! I'LL LET YOU SEE SOME OF THE INDOOR PICTURES WE'VE TAKEN WITH THEM.

FIRST, I WANT TO SHOW YOU HOW EASY THESE MAGIC NEW LAMPS ARE TO USE. SET YOUR CAMERA FOR "TIME". OPEN THE SHUTTER. FLASH THE LAMP AND THEN CLOSE THE SHUTTER. THAT'S ALL THERE IS TO IT.

AND THIS IS ONE OF THE INDOOR PICTURES MARGE TOOK





For indoor snapshots use this lamp

For time exposures use this lamp

Here are a few of the many picture subjects these two lamps open to you:

Night sleigh rides	Anniversaries
Night skating parties	Babies
Valentine parties	Pets
Birthday parties	Home portraits

All of these pictures, including Marge's indoor snapshot, were taken with G. E. MAZDA Photoflash lamps

PHOTOFLASH

For action pictures

To snap action scenes, babies, pets, parties, INDOORS, as easily and as vividly as you shoot them outdoors . . use G. E. MAZDA *Photoflash* lamps to aid your camera. They operate simply, in light socket or handy flashlight battery reflector.

PHOTOFLOOD

For time exposures

For time exposures, portraits, and interiors, use G. E. MAZDA *Photoflood* lamps. Their powerful, continuous light produces beautiful, crisp pictures. *And they are also the best lamps ever developed for taking home movies.*

• • •

Ask your dealer about these two amazing picture-taking lamps. Better still, get some lamps and take some prize pictures. General Electric Company, Nela Park, Cleveland, O.

GENERAL ELECTRIC
MAZDA PHOTOFLOOD and PHOTOFLASH LAMPS

GOOD AND BAD EXAMPLES OF HOME PORTRAITURE

Portraits as effective as the first of these two can be taken easily by any amateur. A photoflash bulb is used and, in addition, a photoflood bulb is placed in the floor lamp to make it appear brightly lighted. The second view shows what happens if you hold the photoflash so that light is reflected into the lens

Testing photoflash bulbs to be sure they are ready to be used

streaming through the windows and shoot the flash as though it were night. Open the shutter only long enough to touch off the flash.

In pictures of this type hold the photoflash lamp to one side and above the camera so as to illuminate everything as uniformly as possible. For all close-up pictures of specific objects, whether humans, animals, or still life subjects, the flash lamp should be carefully placed to give shadows that will make the object stand out from the background. This can best be done by holding a 100-watt light in various positions while you study the effect.

WATCH carefully for unwanted reflections. Any glass surface, in fact any shiny surface—even such a dark object as polished mahogany—may reflect from the photoflash into the lens and so spoil the picture.

The first of the two portraits at the top of this page was made with the aid of a photoflash lamp. The ordinary bulb in the reading light was removed and a photoflood bulb substituted. This is a good trick in any case where it is desirable that a lamp in the picture area appear brightly lighted. The photoflood is so strong that it will give the proper effect during the brief time the shutter is open for the flash.

To show what a bad reflection can do, I took the same view again, but moved the photoflash lamp over a bit so that the light reflected directly from the hanging mirror into the lens. The resulting glare, as you can see in right-hand illustration, fogged out the whole upper portion of the picture.

Because a mirror is such a perfect reflector, it causes the worst glare. The glass in a picture or window frame is not quite so bad. Broad varnished or enameled surfaces produce less intense glare but because of the irregularities in the surface, a large area outside the true point of reflection also picks up light.

The spreading of the bright spot over areas not actually receiving any undue amount of light is known as halation and is worst with single-coated glass plates. Modern, fast, double-coated, dyed-back amateur roll films and film packs such as verichrome are least subject to halation. In any indoor photoflash pictures where there are intense bright spots such as sunlight streaming in a window or gleaming reflections from polished metals or glassware, the use of the modern double-coated film will help to get clearer and better pictures.

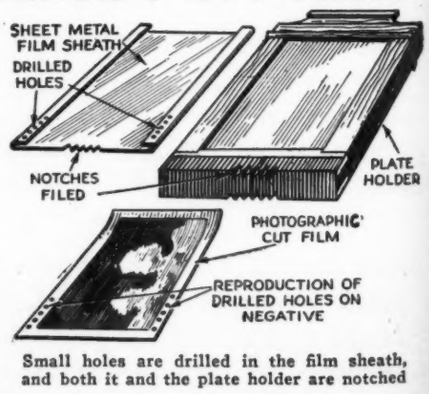
Foresight in photography includes making sure that your equipment is in working order as well as in studying the possibilities of a picture before you press the button. This applies to photoflash lamps. Like any other electric bulb, there always is a chance that extra rough handling during shipment has broken the filament which sets off the flash.

Although the clerk behind the photo supply counter will grin in a superior fashion and tell you it can't be done if you ask him to test photoflash bulbs, the trick can, nevertheless, be done—and quite simply, too. It is easy to make sure that the filament is intact without touching off the flash. How this is done is shown in the illustration at the left.

YOU need a socket for electric light bulbs, one for miniature lamps, three 1 ft. long pieces of insulated wire, and one flashlight bulb. Connect one terminal of one socket to one terminal of the other socket, then clamp the remaining two pieces of wire to the remaining terminals of the two sockets. Screw the photoflash lamp to be tested into the large socket and put the miniature bulb in the little socket. Now touch one of the bared wire ends to the base of one cell taken from the handle of the photoflash lamp. Touch the other wire end to the small brass cap on the other end of the flashlight battery. If the miniature lamp glows, the photoflash bulb filament is intact.

DOTS ON MARGIN IDENTIFY CUT FILMS

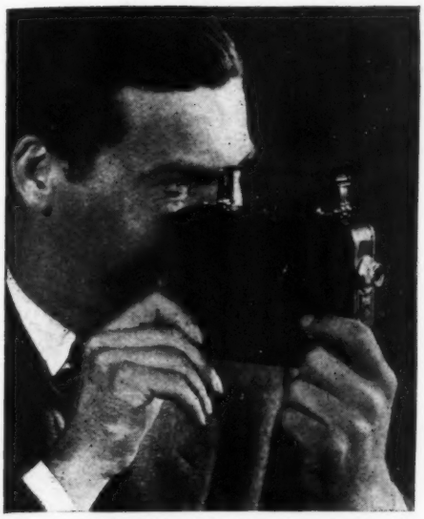
IT IS often desirable to mark cut films to distinguish their time exposures and to make it easier to identify the dates and description of the subjects being photographed. Here is an easy way of marking the films. Drill small holes on each side near the bottom of the film sheath, the number of holes progressing from one up so they can be used in rotation to correspond with the plate holders on hand. File the same number of notches in the lower edge of the film holder and also on an outside corner of the plate holder. The object of the notches is to be able to locate a film holder even when working in complete darkness.—GEORGE SOLKOVER.



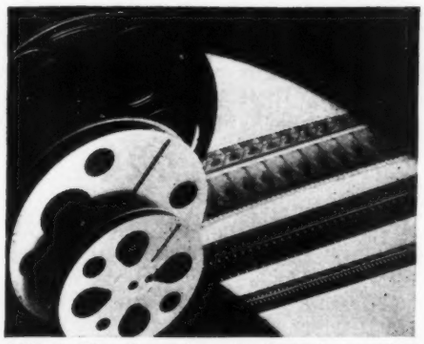
Small holes are drilled in the film sheath, and both it and the plate holder are notched

EASTMAN NEWS BULLETIN FOR THE AMATEUR PHOTOGRAPHER

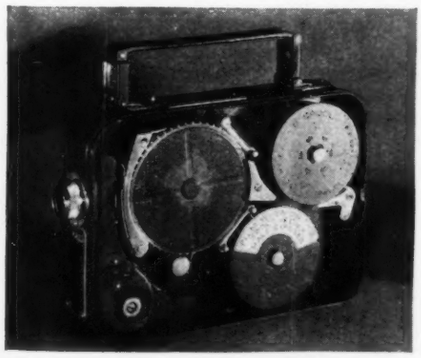
FEBRUARY, 1933, PUBLISHED BY EASTMAN KODAK COMPANY



The new Ciné-Kodak Eight is so inexpensive that practically anyone can afford it. Price, only $29.50. The film, at $2.25 for a roll long enough for a couple of dozen scenes, gives you movies at 10 cents a shot.



A Movie Film Comparison. At the back, a reel of standard professional movie film. Center: A reel of usual 16 mm. amateur film. Front: The extremely compact new 8 mm. film. All three reels run the same length of time.



Interior of the new Ciné-Kodak Eight. Note the simple film path, the extremely compact arrangement of parts. Ciné-Kodak Eight is remarkably easy to operate, and slips into a coat pocket.

Modern Film Has Two Sensitive Coatings

"Two heads are better than one." So are two coatings on the film you use . . . They safeguard snapshot results. The two coating principle is used in Kodak Verichrome Film to give better snapshots and protect against both under- and overexposure. The top coating is fast, to catch the dark parts of the picture. The under coating is slow to hold the bright parts without overexposure. Working together the two coatings hold clear, crisp detail throughout the picture, even when somewhat under- or overexposed.

Make Home Movies at Ten Cents a Shot

with New $29.50 Ciné-Kodak Using New Low Cost Film

HERE is a new Ciné-Kodak with which you can get twenty to thirty action scenes of adequate length on a roll of film costing only $2.25, finished and ready to show on the screen.

This remarkable movie camera works on a new principle and uses a new type of film, which is able to record sharp, detailed images in extremely small size, on a half-width of 16 mm. film. These images are so perfectly formed that they can be enlarged into clear, brilliant pictures on the home size movie screen.

The new Ciné-Kodak Eight takes full advantage of this improvement. It uses a 25-foot roll of the new film in 16 mm. width. In the camera, small pictures are made along one half of the film, after which it is reloaded in the camera and pictures made along the other half. The 25-foot 16 mm. film is then processed by Eastman without further cost, slit and spliced and returned as a single 50-foot 8 mm. film ready to project—equivalent in picture making time to 100 feet of 16 mm. film.

Photography— a Hobby for Millions

"My camera has been almost a 'doctor's prescription,'" says one ardent enthusiast. "It has given me an absorbing interest outside of my work, something I needed to make me really happy." This man's experience represents the feeling of millions of picture makers. Perhaps you, too, are looking for something to add spice to your leisure hours. Try photography. Join our clan.

New European Type Kodak

From Eastman's German factory comes the Kodak Recomar, a camera of wide capability — allowing the use of supplementary lenses, long bellows, ground glass focusing, frame finder, and option of film packs, plates, or cut film. The Recomar has an *f*.4.5 anastigmat lens and is available in two popular sizes—2¼ x 3¼ and 3¼ x 4¼, at $40 and $48, respectively. A booklet describing the Recomar and other Continental Kodaks will be sent you on request.

February Picture Taking Notes

This is the season for snow pictures. Remember the use of a color filter will slow up the blue glare of the snow to give other objects a better chance to register on the film and to give greater depth to shadows in snowscapes.

• • •

Don't forget that the light is weaker at this time of year. Allow double the summer exposure for outdoor subjects other than snow scenes.

• • •

Do you realize how much color adds to snapshots? A few evenings spent with Kodak Transparent Oil or Water Colors enable you to make your pictures much more interesting.

• • •

Are you keeping your prints in order? With a Simplex Album you need only slip standard sized prints underneath raised corners and your prints are mounted in permanent form.

• • •

QUESTION: *Have you a copy of the Kodak Book—"How to Make Good Pictures"? 50 cents at your dealer's.*

World's Smallest Roll Film Camera for Its Picture Size Now Has *f*.4.5 Lens

The Kodak Six-16 shown above is the smallest roll film camera taking a 2½ x 4¼ picture. This camera, hitherto available with single, doublet, or Kodak Anastigmat *f*.6.3 lens, is now available with the fast *f*.4.5 Kodak Anastigmat. The price is $30. Kodak Six-20, for 2¼ x 3¼ pictures, with similar lens is $28. Kodak dealers have both.

P. S. 2-33

INFORMATION REQUEST

Eastman Kodak Company, Rochester, N. Y. Please send me literature regarding items mentioned in your February Bulletin, as checked below.

Ciné-Kodak Eight ☐ ☐ Continental Kodaks
Ciné-Kodak (16 mm.) ☐ ☐ Kodak Six-16

Name.....

Street.....

City.....

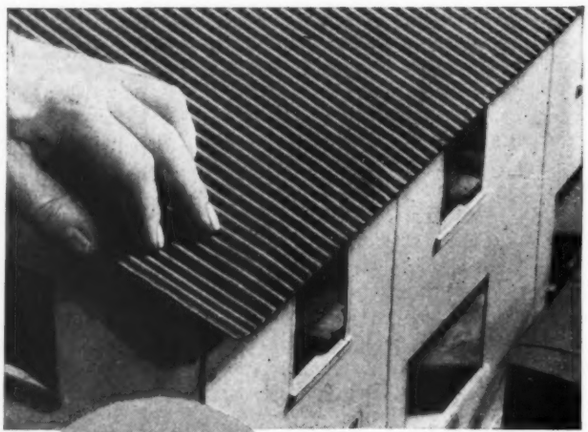
Simple Scenic Effects
THAT IMPROVE A
Model Railway
. . . and other hints

MOST model railway enthusiasts pass up the job of building elaborate scenery because the work looks complicated and difficult. This frequently is true if intricate wooden structures are built for stations and so on, but if cardboard, scissors, and gluepot are used instead, the work is far simpler, less costly, and equally effective from a scenic standpoint.

The cheapest varieties of cardboard—for example, the kind that is stuffed in your shirt when it comes from the laundry—are as good for the purpose as expensive Bristol board. On large structures such as the warehouse illustrated, the cardboard is attached to a light framework made by ripping scrap lumber into thin strips. This illustration also shows how to give the effect of a corrugated iron roof by using corrugated paper with the grooved side uppermost.

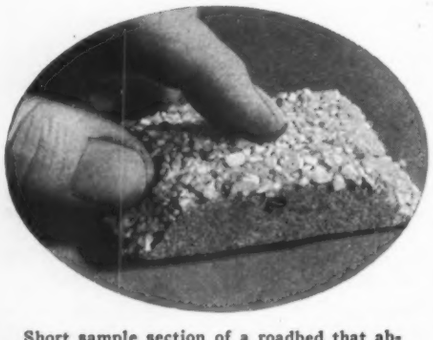
The tarred paper roofs used on small sheds and outbuildings can be imitated in miniature by gluing on strips of dead black paper and pushing in small tacks at intervals to simulate the usual roofing paper fasteners. The local photographer, who throws away quantities of this paper, will be glad to give it to you.

Shingling on roof or side walls of a building can be imitated by cutting cardboard into strips about twice as wide as you wish the exposed portion of the shingle to be. Then rapidly slit one edge of each strip, making two cuts at each slit so that a tiny slice of material is removed. The first cut should go straight in, the second should go straight in for a distance equal to the exposed part of the shingle and then swerve over into the other cut. Irregularity both as to the spacing of the slits and the amount sliced from each is desirable. The photograph in the circle shows how the rows of "shingles" are glued in place. An application of real shingle stain of any desired color will then complete the job.—THOMAS W. ARNOLD.



A cardboard covered warehouse
At left: Quickly laid shingles

Thick Fiber Board Roadbed Helps Reduce Noise

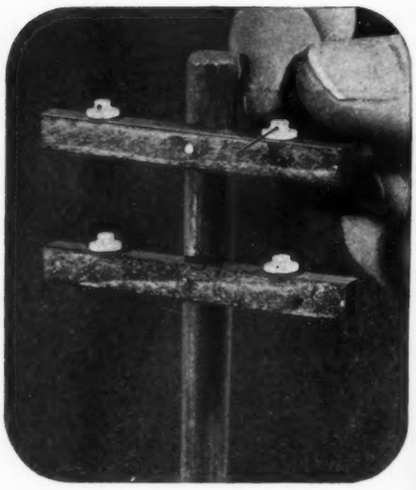


Short sample section of a roadbed that absorbs noise. It is made in long strips and covered with glue and finely crushed stone

A ROADBED that greatly improves the realistic appearance of the model railroad and at the same time absorbs much of the noise of operation can be made from the thick, easily cut fiber boards now so much used as heat insulation in building operations.

A short sample section is shown at the left. The large boards are first cut into strips and then the edges are beveled with a strong knife or a coping saw.

A layer of glue is painted on, and this is covered with chicken grit, which is a finely crushed marble, or with a very fine grade of crushed bluestone, if obtainable. After the glue has set firmly, the excess chicken grit is shaken loose.—ROBERT W. HYDE.



Button Insulators Used on Telegraph Poles

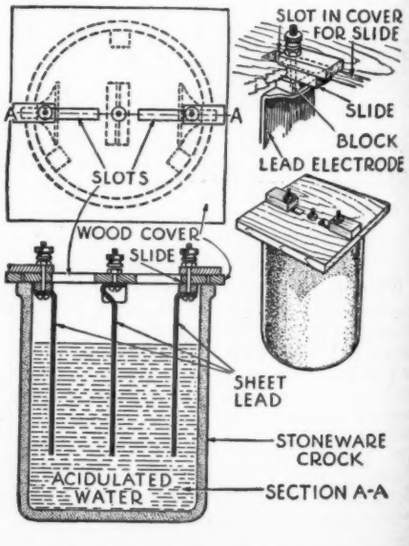
THE construction of model telephone and telegraph poles is relatively easy, but obtaining suitable insulators often is a problem. The pole above is made of dowel rod with slots sawed into it to receive the crosspieces. Poles and crossbars should be stained by dipping before assembly. The insulators are tiny white buttons of the type shown. These are set eyelet side up and held in place with a drop of glue.

A Two-Circuit Rheostat

THE conventional way to make a liquid rheostat with one fixed and one movable plate can be improved upon, as shown below, to handle two portions of the model railway track circuit independently.

A 1-gallon stoneware crock holds the water, to which dilute sulphuric acid should be added, drop by drop, till the rheostat has the resistance desired. The square wooden cover should be a bit larger than the top of the crock. Fit three small wooden blocks underneath the cover to keep it in position. The fixed sheet-lead electrode is bolted to the center of the cover after two slots have been jig-sawed in the positions shown. The slides, which carry the movable plates, are each made of three small blocks of wood.

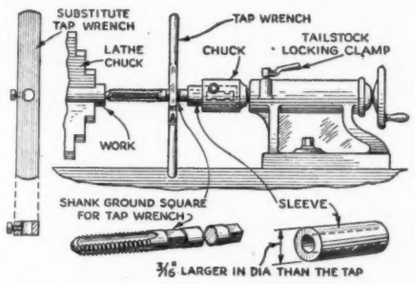
The wire leading from the power transformer is connected to the fixed electrode.



SLEEVE SUPPORTS SMALL TAPS USED IN LATHE

WHEN it is necessary to tap small holes centrally in work held in the lathe, I find the following method aids in holding the tap in line and also reduces the danger that the tap will break. I take a piece of round cold-rolled steel or drill rod about 3/16 in. larger in diameter than the tap shank and drill a hole lengthwise through it so that it is a nice sliding fit for the tap shank. This sleeve is held in a drill chuck in the tailstock.

The shank of the tap is ground square at a point near the threaded portion so

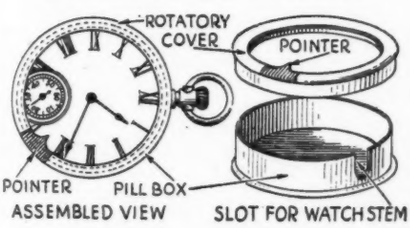


With its shank held in the sleeve, the tap is less likely to run out of line or break

that the tap wrench can be applied to it there. Then the tap is placed in the wrench and the tap shank in the sleeve. The tailstock is moved along until the tap is up to the work, whereupon the locking screw is fastened and the tapping begun. The tap can turn and slide, yet it is well lined up and supported.

A substitute for a tap wrench can be made as shown from a piece of stock just thick enough to allow a small set screw to be used. With such a wrench it is necessary only to grind a spot on the tap for the screw to bear against, instead of taking the trouble to grind a square section as required by the method described in the paragraph above.—D. E. CASWELL.

A PILL-BOX TIMER FOR DEVELOPING PHOTOS



TIMING the development of photos with a watch and endeavoring to remember the exact minute when each should be removed, led one amateur to construct the pill-box timer illustrated.

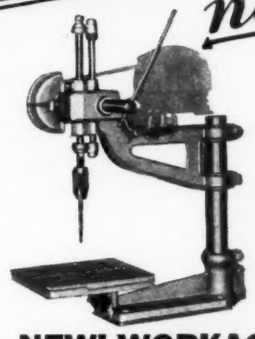
A pasteboard pill box, slightly larger than the watch, was chosen, and a disk was cut from the cover in such a way as to leave a projecting pointer, as shown. A slot was then cut in the side of the box to receive the stem of the watch.

In use, the watch is set in the box, and the cover is placed over the box and turned so that the pointer indicates the time when the photo is to be removed from the developer.—G. E. HENDRICKSON.

...use WORKACE Machines...

...based on the experience of **60,000** **INDUSTRIAL WALLACE MACHINES**

new



NEW! WORKACE Radial Drill

An ideal machine for home or shop. Large capacity, will drill center of 26" circle. Radial feature permits swinging head away from bench to drill large work standing on floor or for drilling a number of holes without moving work. *Arranged for floating drive.* Spindle travels 4½". Maximum chuck capacity, ⅝". Table size 10"×10", tilts 45o both ways. Attachments available for mortising, as well as bits and drills for composition wood and metal.

Bench Model Radial Drill **$16.75** F O B Chicago

Floor Model Radial Drill **$24.75**

Wall Model Radial Drill **$24.75**

The worth of a machine is judged by its *fitness to perform its work and in the time it saves the operator.* WORKACE MACHINES offer a greater degree of accuracy, simplicity of adjustment, large capacity, and sturdiness of construction than any other machine in its price class.

WORKACE Circular Saw

$10 f o b Chicago

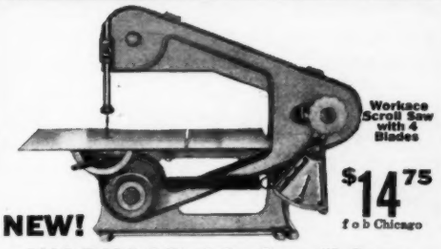
Will cut at any angle, either cross cutting or ripping, or compound angle. Maximum ripping width, 6". Maximum cross cutting width, 5". Maximum depth of cut, 2". Table tilts to 45 o, raises and lowers. Removable throat opening for dado heads, cope heads, etc.

WORKACE 4" Planer

Will joint stock 4" wide and rabbet ¼" deep. Circular safety type cutterhead. Table accurately ground. Rear table provided with rabbetting ledge. Fence adjustable to any point on the table, adjustable to 45 o. **$10** f o b Chicago

WORKACE Jig Saw

Table tilts either way 45 o. Universal blade holder permits use of various types of blades. Maximum depth cut 1½". Capacity using gooseneck, 12". Gooseneck removable giving unlimited capacity. **$10** f o b Chicago



Workace Scroll Saw with 4 Blades

NEW!

$14.75 f o b Chicago

WORKACE 12" Scroll Saw

Blade speed *6 times faster than fastest jig saw.* Maximum space under guide, 4". Maximum width of cut, 12". Blade travels 900 feet per minute. Table, 12" x 12", tilts to 45 dgrs, with automatic stop at square position. Provided with blade tracking device and tensioner. New ball bearing guide. All moving parts enclosed.

WORKACE 36" Lathe

Capacity over tool rest 6" diameter. Capacity over lathe bed 8⅛" diameter. Capacity between centers 36". Non-splitting live center. Equipped with 6" and 12" tool rests. 2-step pulley and 36" V-belt. **$10** f o b Chicago

WORKACE Home Woodworker

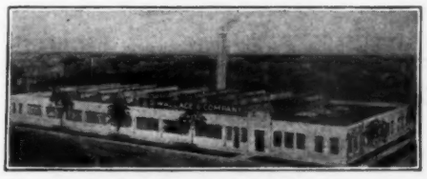
8 Machines in One Compact Unit

Five feet long—and every inch a real tool. Performs 25 different woodworking operations. Consists of 4" Planer, an 8" circular Saw, an 6" x 36" Lathe, an 8" Sanding Disc, a 6" Buffer, a 5" Emery Grinder, a ⅜" Drill Chuck, Auxiliary Tilting Work Table and Jig Saw attachment. Arranged for Floating Drive. Enough power, strength and capacity to do any job in the home shop.

$70 without motor f o b Chicago

WORLD'S LARGEST BUILDERS OF PORTABLE WOOD-WORKING MACHINERY

Send for FREE CATALOG No. 409



J. D. WALLACE & CO.
Wilcox and California Ave.
Chicago, Ill.

J. D. WALLACE & CO.
Wilcox & California Ave.
Chicago, Illinois.
Please tell me more about:
☐ Workace Radial Drill. ☐ Workace Home Woodworker.
☐ Workace Scroll Saw.
☐ Workace Circular Saw. ☐ Workace Planer.
☐ Workace Jig Saw. ☐ Workace Lathe.
☐ Please send complete catalog No. 409.
Name.....
Address.....
City.....State.....

Ease that sore spot and SLEEP

"A little Sloan's will soon put an end to that twitching pain."
"I hope so. I've hardly slept since this last damp spell started."

DAMP-DAY PAINS
—stiff joints

Don't let pain keep you awake during damp weather. Warm those stiff sore joints with Sloan's—and you'll sleep soundly. For Sloan's rushes fresh blood to the sore spot, kills pain, relaxes stiffness. No rubbing is needed with Sloan's—simply pat it on. Gives the quickest relief in the world . . . and costs only 35¢!

SLOAN'S
World Famous Liniment used by 133 Nations

Runners, Rudder, and Sails *for your* ICE YACHT

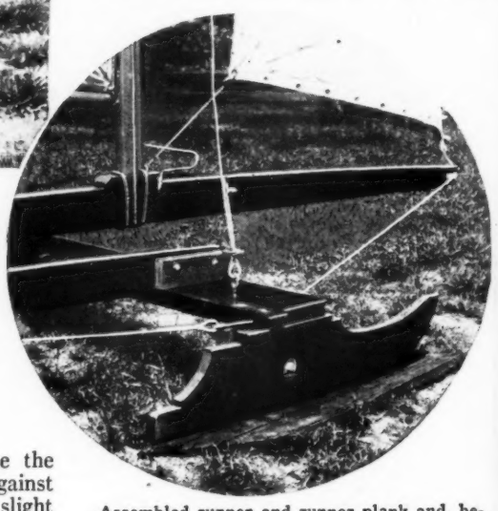
By *Alvin* M. *Youngquist*

Filing the cast-iron shoes, which are bolted to the white oak runners

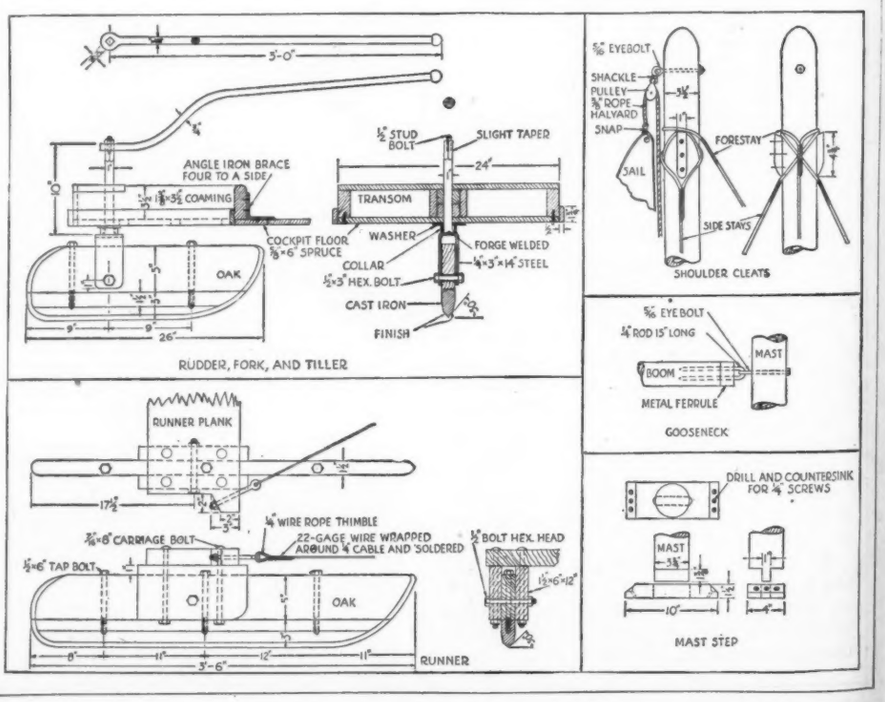
FOR a fast, easily handled ice yacht like that described last month (P.S.M., Jan. '33, p. 64), a great deal depends upon the efficiency of the runners. Cast-iron shoes bolted to white oak tops make the best runners. An 80-deg. angle is machined on the bottom, and it is advisable also to machine the top square to insure a tight fit against the wood. There should be a very slight arch or crown (about 1/16 in. in 24 in. of length) to the sharp edge of the shoes.

The shoes run more smoothly if the extreme forward and the extreme after ends of the sharp edge in contact with the ice are flattened a trifle with a file. This is to prevent excessive chipping of the ice as the runners rock up and down due to irregularities of the ice surface.

The runners rock on a 1/2-in. bolt carried through wood chocks that are bolted to the runner plank. The chock blocks must be bolted perfectly square with the runner plank and parallel with each



Assembled runner and runner plank and, below, plans for rudder, runners, and other parts



WHAT! AS LOW AS $72.75 FOR A Johnson?

no one can afford to buy *any* outboard motor until he has seen the marvelous new developments Johnson offers in its outstanding SERIES 65 FOR 1933

FREE Send for your copy of 1933 SEA-HORSE Handy Chart which gives complete specifications of the 7 great motors in the 1933 Johnson line—and which describes the new developments.

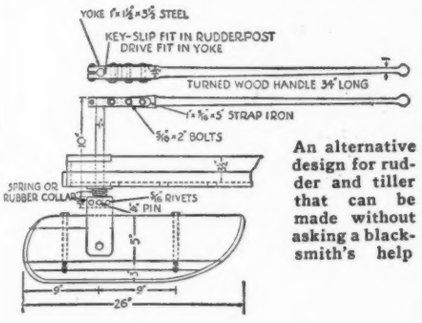
Synchro-Control
Sight Gas Guage
Taper Tube Underwater Exhaust
Certified Power
Portage Steering Handle

JOHNSON MOTOR CO.
500 Pershing Rd., Waukegan, Ill.
Canadian Johnson Motor Co. Ltd., Peterboro, Canada

JOHNSON SEA-HORSES

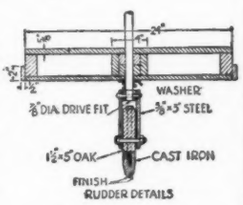
other. It is advisable to fasten the blocks completely on one end of the plank with as much accuracy as possible, but on the other end bore only the forward holes and bolt each chock with one bolt. When the boat is on the ice, push it along and adjust the runner that is partly secured until it tracks perfectly on the ice with the other runner, and then bore the after holes for fastening the chocks permanently.

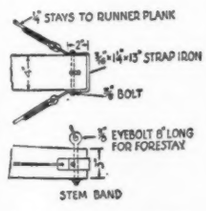
The rudder is similar to the forward runners, but instead of having fixed chocks it rocks on a bolt through an iron fork that is fastened to the tiller post. The fork is constructed of parts



An alternative design for rudder and tiller that can be made without asking a blacksmith's help

pinned and riveted together as shown in the drawings, or it may be a bent U-strap of 3 by 5/16 in. steel, forged to the tiller post. Both types of forks are shown so that the builder may select the one for which his equipment and facilities are adapted. One involves machine shop work and the other may be made by a blacksmith. Likewise, two types of tillers are shown, one a simple forged job, and the other an assembly job consisting of a turned wooden handle bolted to straps, which in turn are bolted to a yoke keyed to the tiller post of the fork. The latter has one advantage in that the tiller is hinged by means of the one bolt through the straps and yoke and may therefore be raised or lowered to the position most convenient for the helmsman.

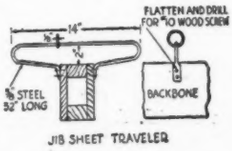




Stem band at front end of backbone with stays to runner plank

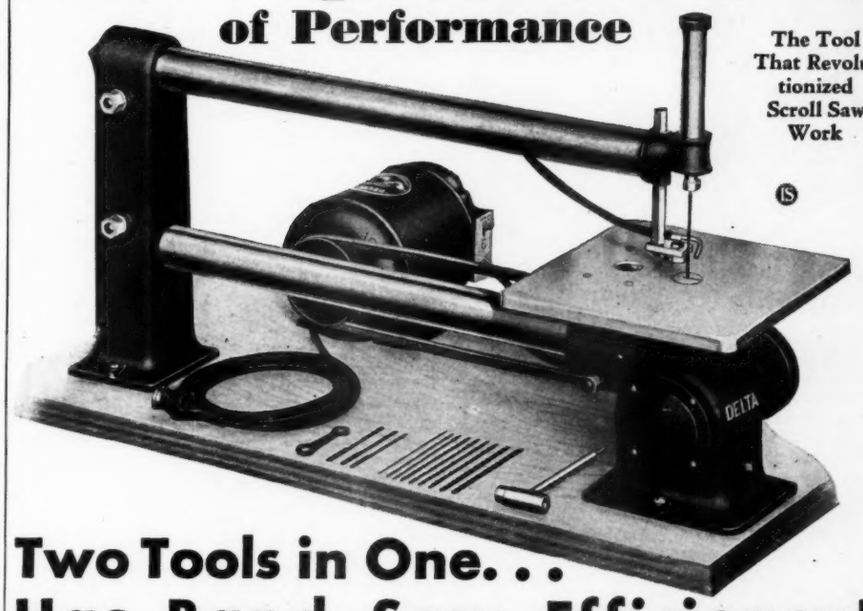
A short, stiff spring or a rubber collar placed over the tiller post under the backbone to relieve somewhat the jar from rough ice is desirable but not essential. In fact, a steel collar may be used.

The sails should be made of closely woven 7- or 8-oz. sail cotton and should be bound with 5/16-in. manila rope on all sides. There *(Continued on page 87)*



Section of backbone showing jib sheet traveler, and an end view of this simple attachment

New Scroll Saw Makes Splendid Record of Performance



The Tool That Revolutionized Scroll Saw Work

Two Tools in One... Has Band Saw Efficiency!

SINCE its introduction last year this new model "Delta" Scroll Saw, radically different in design, has been installed in many thousands of woodworking shops, home workshops, schools, jigsaw puzzle factories all over the United States. Everywhere it has made splendid records of achievement. Everywhere it has won the deep praise and unbounded admiration of woodworkers.

And no wonder! Its unique design and careful construction enable this saw to run at **full motor speed** with all springing and twisting eliminated. At 1,800 strokes per minute it has such perfect balance, such absence of vibration, that a pencil can be stood on end on the saw table without tipping over. This is the only scroll saw of this type on the market today that can pass this rigid test.

As a result, this amazing tool produces fine, smooth, accurate work hitherto possible only on a bandsaw. Has 24-inch throat capacity. Works on metal and fibre as well as wood. Can be used for filing, sanding, and honing. Priced astonishingly low, within the reach of all. For full details, send for the FREE 1933 "Delta" Catalog of Woodworking Units.

A Complete Line of "DELTA" Tools

"Delta" Woodworking Units are convenient, portable, and compact. All are available in a large variety of combinations and at prices to fit all needs. The "Delta" line includes Jointers, Circular Saws, Band Saws, Woodturning Lathes, Drill Presses, Scroll Saws, Boring, Routing, Sanding, and Mortising Attachments—and a complete line of accessories.

Catalog FREE

Shows the complete line of latest "Delta" Tools. It is packed full of interesting illustrations and descriptions. It describes the latest developments in motor-driven equipment at the astonishingly low 1933 price levels. For FREE copy fill out coupon at the right and mail today!

10-DAY TRIAL

Easy Terms Because "Delta" Woodworking Tools are efficient and practical under actual working conditions, they are always available for a 10-Day Trial without the slightest risk. Satisfaction is guaranteed. For full details of this liberal offer and also of "Delta" Easy Payment Plans, fill in and mail the convenient coupon below, TODAY!

DELTA MFG. CO., 3775 North Holton Street Dept. B233, Milwaukee, Wis.

Delta Mfg. Co., 3775 N. Holton St. Dept. B233, Milwaukee, Wis.

Please place me, without obligation, on mailing list to receive the **Free** 1933 "Delta" Catalog of Quality Woodworking Tools. Also send full details of your 10-Day Trial Offer and Easy Payment Plans.

Name.....Age?.....

Address.....

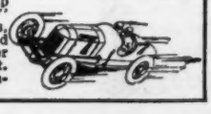
City.....State.....

"BOATS" ASSEMBLE A BOAT THIS WINTER!

Use our completely assembled frames and machined parts. 44 designs, all easily assembled at home. Have a better craft and save 2/3rds the cost. A "WELCH BOAT" is the finest you can own. Send 10 cents for 30 page catalog. WELCH BOAT COMPANY, 3144 North 31st Street, Milwaukee, Wisconsin.

Automobile Racing—NEW BOOK

Ten Chapters. 137 illustrations, of dirt and championship cars and drivers. How to build cars and bodies. Converting stock cars to 120 m.p.h. racers. Answers all questions on speeding up cars; superchargers, "revs" balance, speed, contest rules, track records, etc. Postpaid $1.00. C.O.D. $1.12. Order NOW. **Ray F. Kuns, Dept. D, Madisonville, Cincinnati, Ohio.**



This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS.

Shown ready for lower magnifications. For high powers tube is extended.

Nature's Miracles

Magnified Mosquito

New Gem Microscope Magnifies 75 to 300 times

OBSERVE cruel bacterial life in all its voracious phases, luxuriant forests of molds, amazing botanical adaptations to assure fertilization, complexities of mineral aggregates, living blood corpuscles, preying monsters in a drop of pond water, intricate mechanism of a fly's foot, astonishing compound eyes of insects, inexhaustible thousands of ever-new wonders. Made by Bausch & Lomb, America's largest optical institution, who supply the costliest microscopes to doctors, scientists, laboratories. Extremely simple to use. Lasts a lifetime. Combines features never before offered at this price. With velvet-lined case, prepared specimen, glass slide, extra high-power objective, series of lessons, all for $18. At dealers, or direct from us.

Write for free literature.

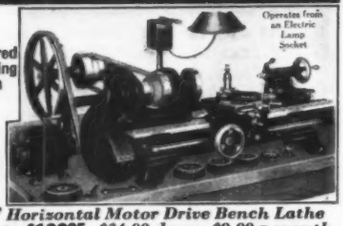
BAUSCH & LOMB OPTICAL CO.,
747 St. Paul St., Rochester, N. Y.

BAUSCH & LOMB

$34.00 Down for this 8" Bench Lathe

A Back-Geared Screw Cutting Precision Lathe

Weight 240 lbs.



8" x 24" Horizontal Motor Drive Bench Lathe Complete **$132.25** *$34.00 down, $9.00 a month*

Lathe has six spindle speeds—hollow spindle—tailstock set-over for taper turning—cuts screw threads 4 to 96 per inch. Made in 24" to 48" beds. Used by manufacturing plants, machine shops, U. S. Government, and others.

Write for Circular No. 8 describing five types of 8" Bench Lathes, attachments and tools—for every kind of shop.

Factory Rebuilt Lathes—of larger sizes, at bargain prices. Only few available. Write for list.

SOUTH BEND LATHE WORKS
831 E. Madison St., South Bend, Ind.

Thompson BEATS the World on BOATS

BETTER BOATS at Lower Prices

Canoes $38 and up

Rowboats $29 and up

Outboards $36 and up

Motor Boats $495 and up

Two Big Factories

FULL LENGTH SPRAY RAILS—SOMETHING NEW
A TVT Family Outboard motor boat with full length spray rails took first place and time prize in Milwaukee-Chicago Marathon.

Catalog Free—Save Money—Prompt Shipment
Please state kind of boat in which you are interested.

THOMPSON BROS. BOAT MFG. CO. (62)
219 Ann St., PESHTIGO, WISCONSIN (Write to either place) 119 Elm St., CORTLAND, NEW YORK

CREATING NEW WORLDS WITH A MICROSCOPE

(Continued from page 47)

this part of our work, we shall need a few ounces of concentrated sulphuric acid, keeping in mind that it is an active corrosive agent that should touch neither the specimens nor our hands. This is placed in the bottom of a large jar. Suspended from the top of the jar on rubber bands (the fumes from the acid will attack ordinary metals) is a small platform of clean glass. The specimen to be dried is placed on this glass and permitted to remain there for about a week. Of course, a number of specimens can be placed on the glass rack at one time. A drying jar of this type is called a desiccator.

WHEN the week has passed, we prepare our slides before the specimens are taken from the desiccator. After clear or white shellac has been applied to the clean slides with the aid of the turntable, they are placed in a warm oven and left there for at least an hour. The object of this layer or circle of shellac is to provide a small specimen chamber between the slide and the clean cover glass. The rim of shellac should be high enough to allow the cover glass to fit neatly in place over the specimen.

Having progressed thus far, we now place our slides back on the turntable, one at a time, and with tweezers carefully place the specimens. Then a clean cover glass is set in place in such a way that it will be exactly concentric with the circle of shellac. Next a camel's hair brush filled with thin asphaltum varnish is brought in contact with the outer circumference of the cover glass to seal it to the slide. The seal should be examined closely for leaks as air must not reach the specimen. If it does, the specimen will soon become moldy and discolored and unfit for future display. If a leak is detected, it should be smeared with the sealing compound.

By permitting each successive circle of shellac to dry and applying still another, we can build up chambers or cells sufficiently high to accommodate objects of considerable size. It must be recalled, however, that these objects must be transparent or translucent.

FROM what has been said it must not be thought that only transparent specimens can be viewed in a microscope. That would be stretching it a bit. However, when we want a real intimate view, we must be able to see through the specimen. That does not mean, for instance, that we cannot view a fly's leg under the microscope. We can indeed and it often happens that merely the shadow of an object is intensely interesting. In this category we might mention the edge of a razor which appears like a saw even under low magnification. A pin point, while we cannot see through it, appears blunt and resembles a crowbar when viewed at fifty diameters.

In our gardens we can find countless objects that make interesting sights without much preparation. Plant lice or aphids may be examined alive under the instrument with the assurance that they will stand still for minutes at a time. They appear as weird monsters under low power.

In closing, the writer would like to address a word or two to those who would enjoy this work but who, for lack of time, cannot prepare the specimens. A large variety of specimens, already mounted by professionals, may be purchased from dealers in microscopes. When ordering, however, the amateur should make sure that he does not obtain slides that are beyond the power of his instrument.

POCKETKNIFE MODEL OF *MANHATTAN*

(Continued from page 65)

bending the davits a little will correct this.

You are now ready to paint the model as soon as the water line has been marked. Place the hull on a smooth table, hold a pencil point on the edge of a ½ in. thick block, and mark all around the contour of the hull.

For best results give the complete boat a coat of flat white paint. Use a ⅜ in. wide flat brush for this and most of the painting, and a small round brush for the portholes and fittings. When dry, give the bottom, up to the water line, two coats of light red, Indian red, or light Chinese red. The writer prefers to use four-hour enamel, which dries glossy, but artists' oil colors in tubes or lacquers are also suitable. Next paint from the gunwale up with white enamel, except all the decks that are represented by the original upper surface of the hull block *A*. These decks are buff, whereas the promenade and boat decks are white.

Color the smokestacks red, white, and blue as shown on the drawing. Touch the ends of the ventilators with red. The masts and small deck parts are white, which sets them off from the buff decks. Now paint the upper sides of the hull with black enamel, and indicate the portholes with a small brush. An easy way to make the square windows is to paint a black stripe and make lines across in white with the small brush when the black is dry. A touch of glue painted green on the starboard or right side and red on the port or left side will serve as side lights. These are placed on top of bridge *E* at each end.

A simple base can be made of ½ -in. wood 2 by 12 in., painted light green. The edges should be beveled. Two thin screws driven up through the base into the hull will hold the model. Another way is to cut out the center of a piece of cardboard so that the boat can be set into the opening, leaving about 1/16 in. showing below the water line. Mount the cardboard on a frame as shown on page 64, and paint it light green.

List of Materials

Dimensions	No. Pc.	Material
1 7/16 x 1⅜ x 12	1	White pine for hull *A*
3/16 x 1½ x 5⅞	1	White pine for deck unit *B* and funnels
⅛ x ¾ x 6¼	1	White pine for deck unit *C* and *F, G,* and *J*
⅛ x ⅛ x 8	2	White pine for lifeboats, bridge, and *K, L, M*
1/32 x ⅝ x 1¾	1	Sheet metal for rudder, anchors, propellers, and *I*
1/16 x 1 x 1⅝	1	Cardboard for deck units *D* and *H*
1/16 dia. x 2½	1	Soft wire for ventilators
3/64 dia. x 4	1	Soft wire for masts
1/64 dia. x 36	1	Soft wire for davits
	20	Common pins for ventilators, derricks, and booms

Small cans or tubes of paint, enamel, or lacquer in the following colors: black, white, blue, dark red, light red, and buff.

Note: All dimensions are given in inches.

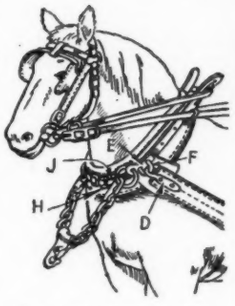
Repairing Harness Saves Money on Small Farms

By L. M. ROEHL

New York State College of Agriculture

MOST communities today have no harness repair shops, and the individual farmer must do his own harness cleaning, oiling, and often repairing, too.

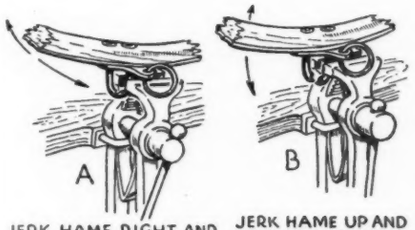
The parts of the harness most frequently in need of repairing are the hames. The hame staple may have to be replaced, and also the hame iron that holds the bottom hame loop if it has been worn through.

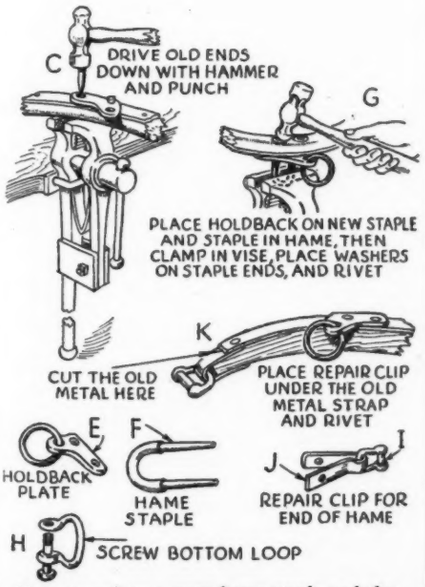


The harness parts that most often are broken

To replace a hame staple:

1. Place one side of the staple in a machinist's or blacksmith's vise as shown at *A* below and jerk the hame vigorously right and left so as to break it if it is not worn entirely through. Then jerk it up and down as shown at *B* so as to break one bar of the staple *(Continued on page 85)*




C
DRIVE OLD ENDS DOWN WITH HAMMER AND PUNCH
G
PLACE HOLDBACK ON NEW STAPLE AND STAPLE IN HAME, THEN CLAMP IN VISE, PLACE WASHERS ON STAPLE ENDS, AND RIVET
K
CUT THE OLD METAL HERE
PLACE REPAIR CLIP UNDER THE OLD METAL STRAP AND RIVET
E
F
I
J
HOLDBACK PLATE
HAME STAPLE
REPAIR CLIP FOR END OF HAME
H
SCREW BOTTOM LOOP

How to replace a worn hame staple and the hame iron that holds the bottom hame loop

"Yes, *I believe it*"

An Open Letter from a happy man

"PUT this on your 'believe it or not' list. My promotion and raise came from reading and believing this statement: 'EVERY hand tool needs oilstoning often.'

"I had all the boys in the shop oilstone their tools for a few minutes one morning as an experiment. Ye gods! What a bunch of smiles! Cheerful workers, better work, faster work! Three months of this, and they gave me the big room with twice as many machines and men. I read about oilstoning in the Norton-Pike book—a brainful of the smartest dope on sharpening ever spilled on paper by some sharp who knows sharpness forward and backward."

MOST "believe-it-or-not" stuff isn't any use to anybody. This sharpening stuff is of use to everybody except the boy with a drum and a knife. The Norton-Pike book is free to anybody who sends in the coupon below.

A Mineral Museum Worth Seeing

If you saw all the sharpening stones, grinders, wheels, etc. in that fine hardware store downtown, all made by Norton-Pike, you would feel greedy for a private collection of your own. Take a look. Dealers like to show them and talk shop-talk.

NORTON PIKE *Products*

Use What Experts Use

BEHR-MANNING CORP., TROY, N. Y.—*Distributors for the U.S.A.*
Dep't N—

I'm *boning* for the Norton-Pike book, "How to Sharpen". I'm *sharp* enough to ask for it, since it's Free.

Name.....

Address.....

My dealer is.....

His address.....

The old "covered wagon"

BUT NOW YOU'D WANT A LIMOUSINE

You'd much rather ride across the Continent in a modern limousine than in an old covered wagon. Why? Because the limousine has springs, shock-absorbers, and cushions. In a word, because a limousine is infinitely more comfortable.

The same thing is true about shaving with Squibb Shaving Cream. It's more comfortable. The creamy lather acts like a shock-absorber on your razor . . . cushioning the rasp of the blade. Squibb's contains a special ingredient . . . a soothing balm . . . that seems to put ball-bearing smoothness in shaving. And best of all, the comfort is a *lasting comfort.* For Squibb Shaving Cream supplies oils essential to the comfort of the skin. Try it and see how pliant, smooth, and downright satisfied your face feels.

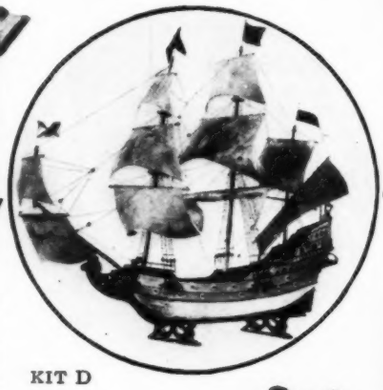
Send 10c for a generous guest-size tube to E. R. Squibb & Sons, 2302 Squibb Building, New York City. Or get the regular over-size tube at your druggist's.

• To give yourself the last touch in clean, comfortable shaving, use Squibb Talcum. Scented or unscented. Delightfully soft and absolutely pure.

Our CONSTRUCTION KITS

Will Save Your Time

KIT NO. 3



KIT D

KIT NO. 4

BY SENDING $1 to the Popular Science Homecraft Guild, you can obtain a construction kit of raw materials for making a highly simplified 12 in. long model of the new American built liner *Manhattan.* The kit contains a piece of white pine for the hull, sawed to the approximate shape but otherwise unfinished; wood of the correct thicknesses for making the various deck units, bridge, funnels, lifeboats, and similar parts; sheet metal for the rudder, anchors, propellers; soft wire for the masts, ventilators, and davits—in fact, everything but the paint. A blueprint showing all parts full size is included.

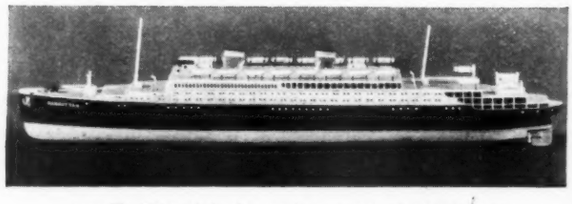
Because of the small size and unusual simplicity of this miniature model, it is an excellent one for beginners and will serve as a pleasant introduction to the fascinating hobby of ship model making.

This new kit is marked *F* in the list below. It will be mailed postpaid to any reader in the United States for $1. The other kits available are also listed. Each is accompanied by instructions or blueprints.

NO. 2

KITS BAND C

KIT A



KIT F—Materials for 12-in. model of *Manhattan*

A. Whaling ship model *Wanderer.* All the raw materials—wood, wire, fishing line, chain, celluloid, and everything but the paints, together with Blueprints Nos. 151, 152, 153, and 154. The hull is 20½ in. long.....$6.90

AA. Same with hull lifts sawed.... 7.40

B. Folding muffin stand in selected sugar pine, 11 in. wide, 19 in. long and 33 in. high when open. All the necessary wood cut to approximate sizes but not machined... 2.90

C. Same muffin stand in birch (can be finished as maple, walnut, or mahogany) 2.90

D. Spanish Galleon ship model, 24 in. long. All the raw materials (except paints), Blueprints Nos. 46 and 47, and a booklet.... 6.45

E. Battleship model, U. S. S. *Texas,* 3 ft. long. All the raw materials (except paints) and Blueprints Nos. 197 to 200..... 6.95

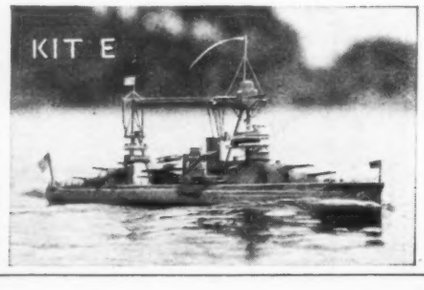
EE. Same with hull lifts sawed.... 7.45

F. Liner *Manhattan.* All raw materials (except paints) for a simplified miniature model 12 in. long, and Blueprint No. 204.. 1.00

No. 2. Solid mahogany tray-top table 23 in. high with a 15 in. diameter top. Ready to assemble..... 5.90

No. 3. Tilt-top coffee table in selected maple with top 19 by 28 in., and 21 in. high. Ready to assemble..... 7.15

No. 4. Solid mahogany book trough 22½ in. long, 9½ in. wide, and 24¾ in. high over all. Ready to assemble..... 5.30



Popular Science Homecraft Guild,
381 Fourth Avenue, New York, N. Y.

Please send me Kit..... for which I inclose $..... (or send C. O. D. ☐)

Note: Prices of all kits except F are 50 cents higher west of the Mississippi River because of heavy shipping charges. This offer is made only to readers in the United States.

Name .....

Address .....

City ..... State .....

(Please print name very clearly.)

REPAIRING HARNESS

(Continued from page 83)

close to the hame. Break the other bar in the same manner.

2. Open the vise about 1 in. and hold the hame over the opening crosswise as shown at *C;* then drive the staple ends down with a hammer and punch so as to project about ⅛ in. on the riveted ends.

3. Cut the riveted ends off, preferably with a hack saw or bolt cutter. If a cold chisel must be used for this, the rivets should be placed on an anvil or other metal support. Then drive the old parts out with a hammer and punch.

4. Place the hame clip of the tug *D* (shown in the small illustration) and the holdback plate *E* on the new hame staple *F,* and drive the staple in place.

5. Clamp the bent part of the staple firmly in the vise with the hame above the vise as shown at *G.* Then place washers on the staple ends and rivet firmly in place. If the hame has iron on both edges, the washers are not used. If the bars of the staple are longer than necessary, they should be cut to project only about ⅛ in. before riveting.

To repair the bottom end of a hame:

1. If the hame iron *K* is still serviceable but the loop is worn, the old loop *I,* if cast, may be removed with a cold chisel and hammer, and a bottom hame repair loop *H* inserted.

2. If the hame iron is worn, place the hame in the vise and cut the hame iron with a hack saw ¼ in. below the rivet.

3. Remove the old rivet. A good way to do this is to center punch the head of the rivet and drill off the head with a ⅜- or ½-in. drill. It may then be removed with a punch and hammer.

4. If the new loop *I* is cast, it should be placed on the repair clip *J* before the clip is placed on the hame. If a screw type bottom loop *H* is used, it may be attached after the repair clip is riveted in place.

5. Place the new loop on the repair clip and the clip on the end of the hame under the hame iron *K.* If it were placed outside of the hame iron, the end would catch the hand when the hame is drawn in place on the collar.

6. Place the rivet through the hole in the hame iron and the repair clip, inserting it from the convex edge of the hame. With the head of the rivet resting on an anvil, vise jaw, or other solid surface, rivet securely in place.

7. File the sawed end of the hame iron smooth.

In a second article scheduled for early publication, Mr. Roehl will give instructions for repairing traces and tugs.

TIGHTENING HINGE PINS

HINGE pins that are so loose that they can be pulled out easily are a nuisance, especially in a home where there are children with prying fingers. To prevent the removal and possible loss of the pins, clean the top of the hinge and the head of the pin, place a drop of shellac on each, replace the pin, and lock the door until the shellac has set. This will hold the pin securely.—ELTON STERRETT.

LOOK!

WORKSHOP ON WHEELS

DRIVER FLEXIBLE SHAFT

Handiest tool for a workshop. Drills holes, removes paint and rust, sands and waxes, grinds metal, polishes your car — does dozens of other jobs.

$8.00 Less Motor

Write for 1933 free Catalogue

WALKER-TURNER CO.
PLAINFIELD, N. J.

DRIVER POWER TOOLS

"Our Readers Say" is getting to be one of the most diverting and interesting features in the magazine. If you have not written in to the Editor of *"Our Readers Say"* why not break into print with some idea that you are interested in. Your letter will be welcome.

RAYDIK BENCH DRILL

This rugged high grade drill is made for precision work, ball thrust bearing in spindle, accurate chuck, adjustable table and ample oil cups. Built for factory, garage or home work. Sales price—

Write for folder on features.

ASHLEY MACHINE WORKS, Inc.
Rochester, N. Y.

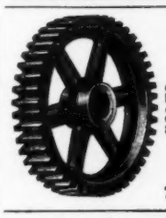
G.E. PHONOGARPH MOTOR

Synchronous 110 Volt, 60 Cycle, 60 R. P. M. Motor

Can be installed in place of old fashioned hand wind spring motors. Many other uses. $12.00 Value ONLY $2.95

These G.E. motors are all brand new in original factory cartons. Fully guaranteed. $12 val. only $2.95. Shipped Prepaid. Order today before too late.

National Elec. Tool Co., 111 W. Lake St., Dept. 262, Chicago



GEARS

In Stock—Immediate Delivery

Gears, speed reducers, sprockets, thrust bearings, flexible couplings, pulleys, etc. A complete line is carried in our Chicago stock. Can also quote on special gears of any kind. Send us your blue prints and inquiries.

Write for Catalog No. 214

CHICAGO GEAR WORKS
769-773 W. Jackson Blvd., CHICAGO, ILL.

KINKADE GARDEN TRACTOR
and Power Lawnmower

A Practical, Proven Power Cultivator for Gardeners, Fruit Growers, Truckers, Florists, Nurserymen, Suburbanites, Country Estates and Poultrymen.

Catalog Free

Reduced prices - Easy Terms

AMERICAN FARM MACHINE CO.
1072 33rd Ave. S. E. Minneapolis, Minn.

Big 12" balsa Glider Free with *each kit!*

Amazing Dipper rises off ground, *flies* like bird! Flew 900 ft. for Latas of Colo.! Weighs ½ oz. *Easily built!* Only 50c prepaid for COMPLETE Kit with Free Glider, in big box! *Order!*

FREE "FLEW 900 FT!"

POST PAID 50¢ the DIPPER

NEW ARMY PURSUIT! "RECORD FLIGHT of 1300 Ft."

75c This khaki, orange colored fighter looks like real Army biplane—*flies real! Easily* built! *Complete kit* & Glider in box, 75c prep'd. ACT!

3 KITS $2

Save 25c—order all 3 kits for $2.00 prepaid. NOTE: Each kit packed in *separate* box—NOT 3 kits jumbled in One box! 3 Free Gliders! *Satisfaction Guaranteed or Money Back!* Sent for Cash or C.O.D.! Get amazing, new 24-page, 5-color CATALOG. Send 2c stamp! *Dealers* write! COMET, 3114 Harrison, Dept. PS-23, Chicago, U.S.A. Order now!

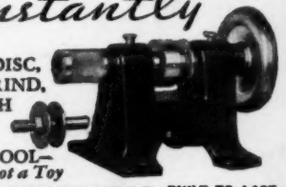
NEW RED RACER

"Speed" ship! Bright red. Easily built, *flies swell!* Hurry! Complete kit & Glider in sturdy, big box, $1 prepaid. Be FIRST to build, fly it! Order!

$1

CHANGE ATTACHMENTS Instantly

CARVE, DISC, DRILL, GRIND, POLISH



A REAL TOOL—*Not a Toy*

MASTER BENCH HEAD BUILT TO LAST A LIFETIME

Each attachment is mounted on a mandrel and is in perfect alignment. To change attachments, merely loosen handwheel and slip into draw-in collett. List price $4.00.

Special Offer. Send $3.00 for Master Bench Head postpaid or C. O. D. We will send you FREE one 4"x¾"x¼" all-purpose grinding wheel and 4" buff mounted on separate mandrels. Write for booklet.

WISCONSIN ABRASIVE COMPANY
Dept. 8522 Station A Milwaukee, Wis.

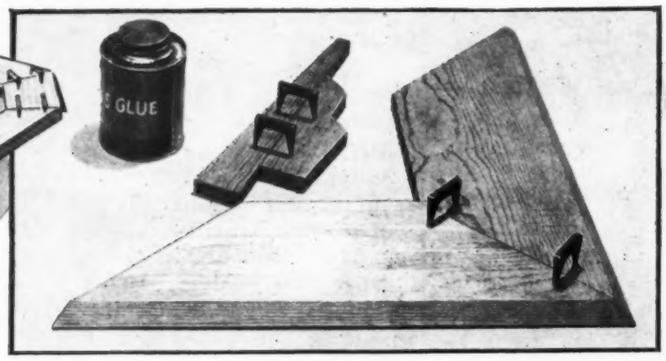
This seal on an advertisement signifies the approval of POPULAR SCIENCE INSTITUTE OF STANDARDS.

ODD-SHAPED PARTS CLAMPED WITH PINCH DOGS

How pinch dogs are applied to draw the parts of a frame together

ODD-shaped, angular, or even plain rectangular pieces of wood often can be clamped or held together for gluing, marking, or fitting much quicker and in many cases more easily with the aid of what are called "pinch dogs."

These handy little clamps are shaped like a very heavy staple with the inner edges of the legs slightly tapered. When the sharp points are driven into the two pieces of wood to be joined, the taper draws the parts together. The clamps are sold by the larger hardware stores, as they are much used by pattern makers and molders; and, of course, they can be made by anyone who is willing to take the time to do so. The indentations left by the clamps, if on the face or finished side, may be filled with a plastic wood composition.—W. H. MCCULLOUGH.



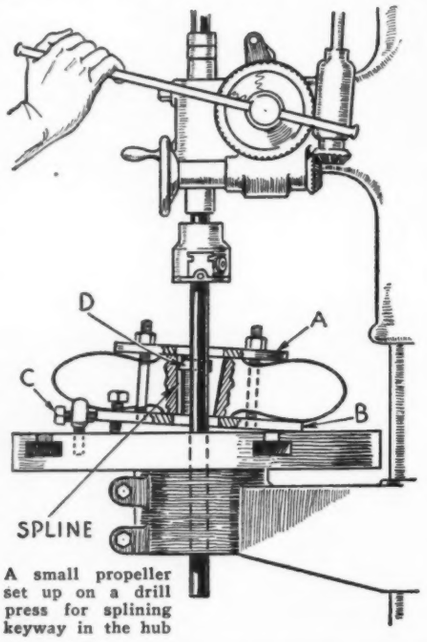
Pinch dogs of the type commonly used by pattern makers and other mechanics

PROPELLER KEYWAY CUT ON DRILL PRESS

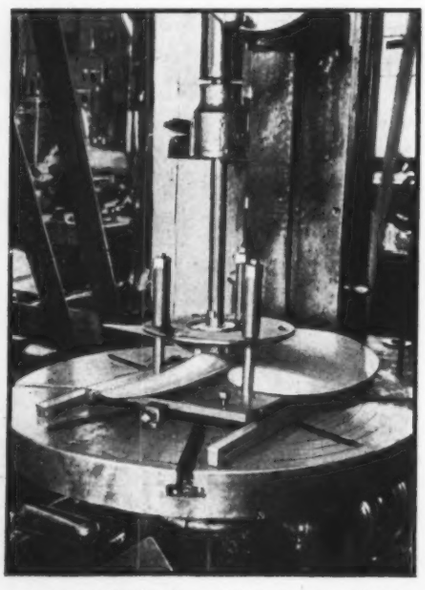
IN THE accompanying illustrations is shown a very simple method of equipping a common drill press so as to cut or spline a keyway in small propellers.

The plate *A* is round and has three holes drilled in it 120 deg. apart to receive the three bolts or threaded rods. The lower plate *B*, to which the bolts are fastened, is square. Two pieces, set parallel on either side of the square plate and held to the drill table by dowel pins, act as guides for the square plate when the feed screw *C* is turned.

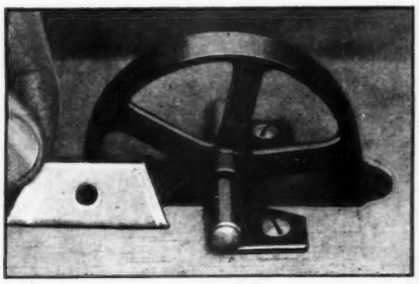
The tool *D* is carried up and down by the drill press feed lever, and with each down stroke of the tool the screw *C* is given a part of a turn. The plate *B* can be raised or lowered to conform to the angle of the propeller hub that is being machined.—MAURICE R. SNOW.



A small propeller set up on a drill press for splining keyway in the hub



The propeller is clamped between two plates, and a screw is used to feed the whole set-up forward at each stroke of the cutting tool

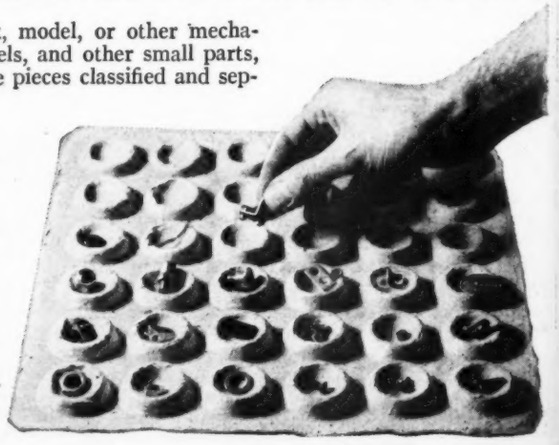


HINGES PROVIDE AXLES FOR TOY WHEELS

WHEN it is necessary to fasten small wheels or pulleys to the woodwork of homemade toys, models, and other devices, it is often a problem to find suitable axles and supports for them. As a rule, however, a good mounting can be made from part of either an old butt hinge or a T-hinge. Cut it away with a hacksaw as shown in the photograph above. The pin can be driven out, shortened if necessary to suit, and again riveted in place. If the hole in the wheel is too small, it can usually be redrilled without difficulty to suit the hinge pin.—F. W. B.

EGG PACKING SERVES AS SORTING TRAY

WHILE taking apart a clock, model, or other mechanism composed of screws, wheels, and other small parts, you will find it best to keep the pieces classified and separated so that you can find them easily at the time you have to reassemble the device. A convenient way to do this is to use one of the fiber sheets made for separating eggs when packed in a crate. Such a sheet contains numerous small, cuplike depressions, each of which will hold several small parts. Identifying names, numbers, or marks may be written on the fiber to prevent any confusion.—ERVIN WALTERS.



Electric Telegraph Set 15c

BOYS! A private Electric Telegraph Set of your own for *15c.* Lots of fun sending messages to your friends. Better still get two sets, hook them up as shown in the directions, for TWO-WAY MESSAGES (sending and receiving.) No trouble at all to operate with the simple instructions that accompany each set. Operates on any standard dry battery obtainable everywhere. With this outfit you can learn to transmit and receive messages by the Morse International Code, and in a very short time become an expert operator. Mounted on wooden base measuring 4 x 5 in., first class construction throughout, complete with key, sounder, magnet, miniature Western Union blanks, packed in neat box with full illustrated instructions—**ALL FOR 15c** (without battery) **postpaid.** (*Canada and Foreign 20c.*)

Add *10c* for 64 page book **"BOY ELECTRICIAN".** Tells how to make batteries, dynamos, motors, radios, bells, engines, etc. **BIG 170 PAGE CATALOG 10c.** Amazing catalog of novelties, tricks, puzzles, jokes, books, etc., *10c postpaid.*

WORLD NOVELTY CO. Dep. 931, Racine, Wis.

A New Magazine

on the building of Authentic Models

of airplanes that fly, ships, trains, complete railroads and equipment, tiny planes, small machinery and other fascinating subjects—all requiring only the simplest tools. No theory. Every plan tested and proved. Plenty of pictures, drawings and simplified steps in

CLEVELAND MODELMAKING NEWS & Practical Hobbies

a long-awaited magazine, every modelmaker will thrill over. Nothing ever like it before. Taking model enthusiasts by storm. Filled with valuable hints, data and articles, and FULL SIZE drawings. Don't miss getting it.

FREE—2 FULL SIZE ¾" scale drawings (Gee Bee Supersportster and Heath Parasol) with introductory issue along with many other items. Rush 25c at once for your copy, which can be credited against $1. subscription price (6 issues) should you want to subscribe—don't delay—send your 25c at once.

Cleveland Model & Supply Co., Inc.,
1866-SB West 57th St., Cleveland, Ohio, U. S. A.

BUILD "GOLDEN HIND"

Make a worthwhile 32½" model in your spare hours. Clear drawings show the true line of Drake's galleon of 1577. Also how to set up masts, rigging line, sails, and flags. Hull comes fully shaped and sanded, with forecastle and decks in place. Outfit includes guns, channels, lantern, all fitting, even paint and brushes for decorating. Complete set for only $9.75 plus 6 lbs. post. Send 18c (coins) for interesting catalog of other models.

ROY HANCOCK
323 S. Douglas Ave. Portsmouth, Va.

DEFEND YOURSELF

Regardless of size or strength, defend yourself and friends against any foul attack, from bullies or by gun, knife or club. Subdue with ease persons much stronger than yourself, even if violent & crazy. A complete course on approved AMERICAN POLICE JIU-JITSU by internationally known police instructor. 155 illustrations with detailed instructions, pocket size. 13 knockout blows without using fists. Send One Dollar, full price; or will send C.O.D. in United States, twenty cents extra.

S. J. JORGENSEN
1575 MARITIME BLDG. SEATTLE, WN.

Build 3 Models for $1.65

Biggest value ever offered: IDEAL 3-in-1 Kit contains everything required to build these 3 Flying Models, including Plans and Instructions. Easily Built. Ask for Set No. 3.

Send 5c for NEW Catalogue

IDEAL AEROPLANE & SUPPLY CO.
28 West 19th St., N. Y. City.

$2.00 WOOD TURNING LATHE

You can turn candlesticks, lamp bases, cigar holders, spindles, vases, etc., etc., on "*The Giftmaker*" 2-speed wood lathe. Runs from your treadle or fractional H.P. motor. Fillsneed for inexpensive, smooth running lathe. Both face plate and driving dog attachments included; also list of 50 articles possible to turn on "The Giftmaker". Sent postpaid for $2.00, C.O.D., $2.25; to Canada $2.50.

Specifications: 13" long overall, 6" high. Takes pieces up to 8" long, 2½" in diameter. All metal construction. Fully adjustable.

J. & H. Metal Products Co., Dept. 2, 490 St. Paul St., Rochester, N.Y.

BUILDING AN ICE YACHT

(Continued from page 81)

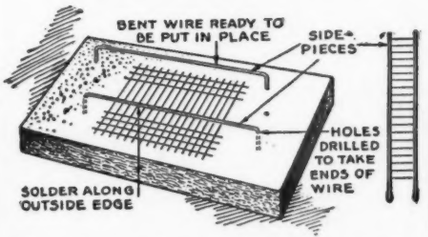
is decided fad these days for colored sails, and your boat can be made distinctive by dyeing the sails in some attractive shade of red, blue, orange, or other color. A waterproof sail cover is inexpensive, and money well spent if you would preserve the sails.

The stays may be either 1/4-in. sash cord or any twisted wire that is not too stiff yet is strong enough to withstand a load of about 1,200 lb. The mast end of the stays is made in a loop to go around the mast and held in place on the mast by wooden shoulder cleats screwed to the mast. The lower ends are served over a thimble through 3/8-in. eyebolts. The ends are made fast simply by wrapping the stay ends with about 22-gage copper wire and then hard-soldering the lap. This makes a strong, neat job. The slack in the stays is taken up by tightening the nuts on the eyebolts through the runner plank.

The other details of construction—mast step, gooseneck, stern piece, and jib-sheet traveler—are so easily made from the drawings that they need no comment here. With the aid of the plans you will have no difficulty in rigging the ice boat.

It is a convenience to have a boat snap spliced into the jib halyard end for quick attachment of the jib, and also a snap at the foot of the jib to secure the jib to the forestay eyebolt. It is customary to take the jib off entirely and furl it with the mainsail so that it is also protected by the sail cover. These snaps are additional to the hardware listed in the bill of materials last month.

SHIP MODEL LADDERS MADE FROM WIRE



IF MAKING the small ladders for the POPULAR SCIENCE MONTHLY destroyer model is a tax on your patience, you will appreciate this easy method: First cut small strips of bronze or copper insect screening (sixteen meshes to the inch) as wide as the ladders are to be high. Then use sharp-pointed scissors to cut out five or six wires from the center of the strips as shown. Lay one of these pieces flat on a sheet of asbestos board or some other suitable surface, tacking it in place if desired. Cut wires of the desired length for the sidepieces, bend the ends as indicated, and drive the latter into holes previously drilled in the board. Solder carefully along the outside edges of each sidepiece. Then sever the strands of wire with a knife so that finished ladder can be lifted off the board. Trim away the excess wire from the sides and cut off the bent ends of the sidepieces.—C. S.

WANT A GOOD JOB?

SHARPEN LAWNMOWERS AND EARN GOOD MONEY

BUILD YOUR OWN PROFITABLE, PERMANENT BUSINESS

Anyone who will earnestly go into the lawnmower sharpening business can make from $40 to $50 per week their first season. Many men have made more than this in their spare time alone. W. C. Fink, Pittsburgh, Pa., writes: "I turned out 604 jobs and my standard price is and always has been $2.00 per mower." Niles C. Race, Rochester, N. Y. writes: "I have to date sharpened 785 mowers at $1.00 each." Wm. Seduski, Watervliet, N. Y. writes: "The Ideal is a wonder, no one can do a bad job on it."

THE IDEAL SHARPENING PRINCIPLE IS USED BY ALL LAWNMOWER MANUFACTURERS

The Ideal Sharpener is a model of simplicity. It grinds the blades of a lawnmower with surprising speed and accuracy without taking the mowers apart. It employs the same method of sharpening as used by all leading lawnmower manufacturers. Fifteen minutes' work will put the average mower in perfect condition and you get from $1.00 to $1.50 per mower.

NO TRAINING NECESSARY

No training is required. Just attach the Ideal to a light socket and start to sharpen. Hundreds of dull lawnmowers are in your vicinity right now, waiting to be sharpened.

NOW IS THE TIME TO START

Solicit lawnmower sharpening business now. Get started early for in this business, "the early bird catches the worm." Write for our

free CATALOG

THE FATE-ROOT-HEATH COMPANY
337-373 Bell St., Plymouth, Ohio

SEND ME YOUR FREE CATALOG.

Name_____

Address_____

City_____ State_____

(Please PRINT your name and address)

"A Baby Can Make It A GIANT Can't Break It"

THESE are the exact words of one of the thousands of enthusiastic CASCO users who have discovered that there *IS* a difference in glues. CASCO Waterproof GLUE because of its exclusive easy-mixing formula, mixes quickly in cold water, forming a smooth, creamy, easy-spreading liquid glue ...absolutely free from lumps. You cannot go wrong with CASCO—equal parts of powder and cold water from the tap make a liquid glue of just the right consistency.

FREE! BIG GLUING GUIDE

Just jot your name on a penny post card, mail to the address below, and we will send you, *absolutely free*, a copy of the CASCO Gluing Guide—50 pages—75 illustrations—containing hundreds of money-saving and money-making ideas on building, repairing and mending things quickly, easily and *permanently*.

CASCO Waterproof GLUE is sold by Hardware, Paint and Building Supply Dealers. Trial package 10c; ½ lb. can 40c; 1 lb. can 65c; also 5 lb. & 10 lb. moisture-proof bags.

CASCO Is Economical... 1 *pound of CASCO makes 1½ quarts of Liquid Glue!*

THE CASEIN MFG. CO. OF AMERICA, INC.
207 East 42nd St. New York, N. Y.

Popularity

comes quickly when you learn to play a band instrument. For quick advancement and greater musical success start on an easy-playing Conn. The choice of the world's greatest artists. Many exclusive improvements at no added cost!

HOME TRIAL, EASY PAYMENTS

Write for details and free book. Mention instrument. C. G. CONN, Ltd.
232 Conn Building Elkhart, Indiana

HOME TRIAL

SHIP MODELS

U. S. S. TEXAS

The quick and easy road to ship modeling is to get one of our accurate scale construction sets. With them you can concentrate on the interesting part of the model. Similar sets for models of Flying Cloud, Destroyer Preston, Constitution, Spanish Galleon, Whaler Wanderer and many others. Also semi-finished hulls and all sorts of materials and fittings such as blocks, deadeyes, anchors, steering wheels, guns, lifeboats, etc. Large 64-page photographically illustrated booklet, describing the above sent postpaid upon receipt of 15c (coin). Many persons on receiving this booklet, have discovered how simple and enjoyable is ship model making. Be sure to get your booklet before starting your model.

Model Ship Supply Co., Dept. W, Mineola, N. Y.

Build Your Own Electric Grandfather's Clock

(Most Accurate and Finest Observatory Type.)

Small installment payments. Clock can be easily and quickly assembled. We supply all parts. No special tools necessary. Send $1.00 for illustrated INSTRUCTION BOOKLET, giving complete details. ($1.00 deductible on last payment.)

Descriptive Circular FREE Upon Request

HARTFORD CLOCK CO. 198 Central Ave. Jersey City, N.J.

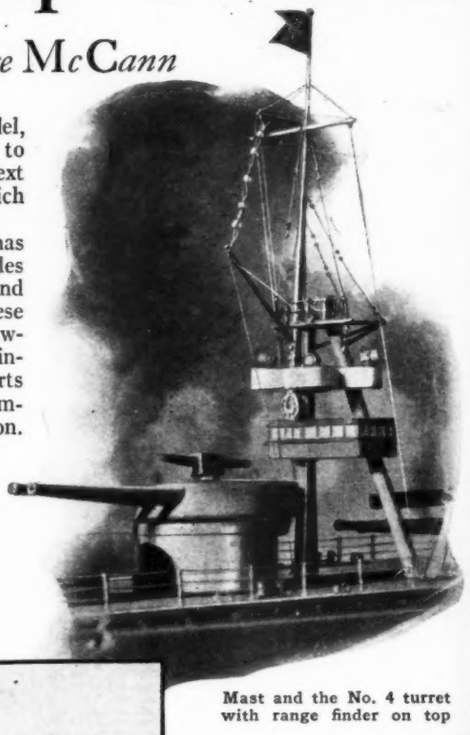
Adding the Armament to Our Model of the Battleship TEXAS

By *Capt.* E. *Armitage* Mc*Cann*

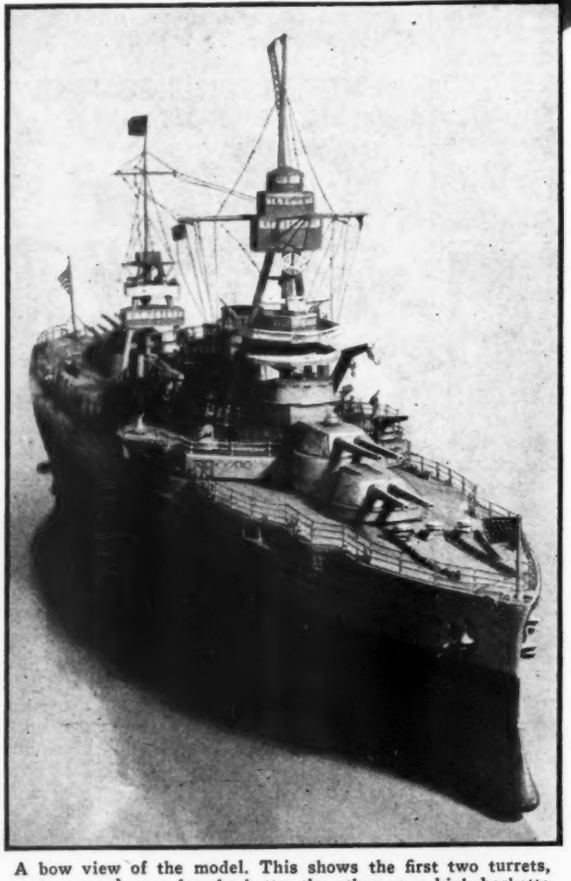
IN BUILDING our battleship model, the U. S. S. *Texas*, we now come to the remaining mast. It is the next erection aft, omitting the armament, which we shall take up a little later.

The construction up to this point has been covered in three previous articles (P.S.M., Nov. '32, p. 67, Dec., p. 71, and Jan. '33, p. 68). In the second of these (Dec., pp. 72 and 73) the complete drawings of the side view, deck plan, and principal details were given with all the parts indicated by numbers. These are the numbers used in the following description.

The mast tripod is like the foremast, but not so high. The legs spread at the same angles and are each 3/16 in. in diameter. The control house *(46)* is made as shown in the drawings just mentioned. It must be carefully bored for the legs. The four-leaf clover above *(47)* for holding the searchlights is made,



Mast and the No. 4 turret with range finder on top

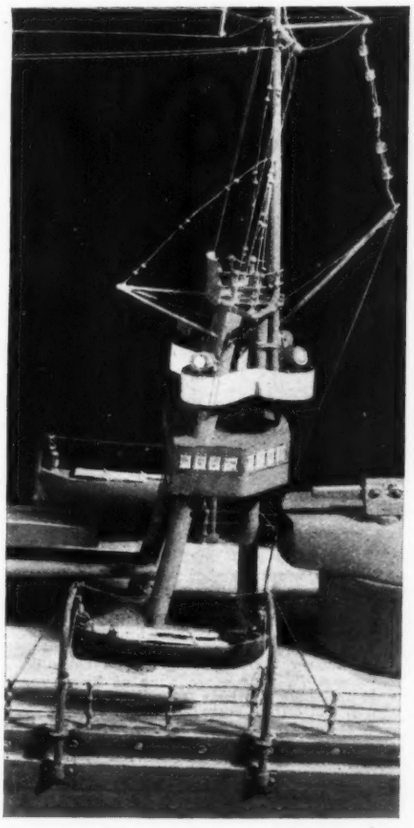


A bow view of the model. This shows the first two turrets, one mounted on a low barbette, the other on a high barbette

like the flying bridges, of 24-gage sheet brass. The weather screen is a strip soldered on.

The lookout-platform above *(48)* is circular, but with a high screen at the fore edge. This I also made of brass, bending the screen up. Abaft it has two-ball stanchions soldered on, with the usual wires running through them. Extending from this at the sides are wires for the backstays *(49)*. These are made in one piece and soldered under the forward and after rims of platform *48*. At the after edge is a scant ⅛-in. hole for the signal mast. This platform is nailed onto the top of the tripod struts.

The mast is barely ⅛ in. in diameter and tapers to about half that. At the position shown is a yard *(50B)*. This is so small that I made it of brass rod, binding it in position with wire. From the same position a short arm extends aft, horizontally. This I also bound



Navy whaleboat and davits and a clear side view of the mast described in this article

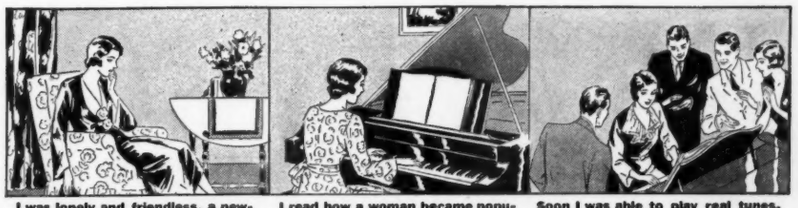
on with wire through a hole in the end. From above come the yard lifts, passing first to the yardarms and then to the end of the horizontal arm where they are fastened with solder.

The mast ships through the hole in platform *48* down to the second platform. It can be fixed with a nail, if of wood. However, as the mast is quite slender and likely to be accidentally knocked if the model is a working one, it is better to make it of brass rod, for which the process will be substantially the same.

From halfway between the platforms extends the flag gaff, made of brass wire. At the yard-lift position I passed the bight of a thin wire, twisted the parts together, and carried them over the end of the horizontal arm, fastening them with solder. Then I threaded four glass beads over both parts, opening the two wires to hold the beads at equal intervals. The bight was now soldered to the gaff, and from there the two separate ends of the wire were run back on each side to the wires for the backstays *(49)*.

From the yard position thin wires run through the ends of *49* to staples in the struts. From a point on the mast halfway between the yard position and platform *48*, similar wires go to the ends of *49*. Still another wire runs from the same halfway point to a heavier wire which extends from the fore edge of the platform. Two supporting wires are soldered at an angle to this horizontal wire and are driven into the after struts. All the thin wires mentioned have six beads spaced in pairs at intervals along them.

In stepping the main tripod, you must be sure *(Continued on page 93)*



I was lonely and friendless, a newcomer to town. Neighbors called once—but never came again.

I read how a woman became popular by learning to play through the U. S. School Course. I enrolled . . .

Soon I was able to play real tunes. Now I'm invited everywhere. They call me "the life of the party."

MUSIC – *the Surest Path to Friends*

. . . so easy to learn this short-cut way

No longer need you envy people who play—who are always the center of attraction at parties—who make friends immediately wherever they go. Now this newly perfected short-cut home-study method can make YOU an accomplished musician. It can bring you the good times you've always longed for.

More than 600,000 men, women, boys and girls, have successfully learned to play their favorite instrument without a teacher the famous U. S. School way. And the cost averages only a few cents a day!

Easy As A-B-C

This new "print-and-picture" method is literally as easy as A-B-C. The U. S. School simplified instructions, written by expert teachers, first *tell* you what to do. Then a picture *shows* you what to do. Then you do it yourself and *hear* it.

And you learn so much more quickly by this modern, up-to-date method than was possible in the old-fashioned, tiresome, scale-practicing way.

Now you play real tunes almost from the start—*by note*. No teacher to fuss you. No wearying scales to plague you. No interference with business or pleasure, because you choose your own time at home.

Prove to yourself without cost how easily and quickly you can learn to play. Send today for our booklet, "How You Can Master Music in Your Own Home." With it comes a Free Demonstration Lesson which shows graphically how simple this expert home instruction really is. Instruments supplied if desired—cash or credit. Mail the coupon TODAY. U. S. School of Music, 82 Brunswick Bldg., New York City.

LEARN TO PLAY BY NOTE

Piano, Violin, Guitar, Saxophone, Organ, Ukulele, Tenor Banjo, Hawaiian Guitar, Piano Accordion

Or Any Other Instrument

U. S. SCHOOL OF MUSIC
82 Brunswick Bldg., New York City

Send me your amazing free book, "How You Can Master Music in Your Own Home," with inspiring message by Dr. Frank Crane; also Free Demonstration Lesson. This does not put me under any obligation.

Name .....

Address .....

Instrument ..... Have you Instrument? .....

SQUARE KNOTTERS

We have spent many years gathering together Square Knot materials. Every individual article offered in our Booklet B (free on request) is a quality article. A post card will bring full particulars.

Or enclose 10c to cover mailing expense and we will mail you our Beginner's Instruction Booklet, catalog and samples.

P. C. HERWIG CO.
Square Knot Headquarters
49 Sands St., Brooklyn, N. Y.

SHIP MODEL FITTINGS

BUILD THE U. S. S. TEXAS

We can supply all those hard to make deck fittings—stanchions, 1-16" and 3-32" airports, guns, davits, capstans, bells, ladders, modern anchors, propellers and shafting. Construction kit for this model if desired.

We also have complete line of hulls and fittings for Sailing Ships, Destroyers, Yachts, etc. Send 15c for illustrated catalog.

A. J. FISHER
1082-2 Etowah Ave. Royal Oak, Mich.

If you like POPULAR SCIENCE MONTHLY why not pass the word along to your friends. When an article in this magazine strikes you as being unusually good, tell your friends to get a copy at the newsstand, and read it.

NEW 1933 *"Boice-Crane"* TOOLS

ONCE MORE Boice-Crane leads the way with new features, new ideas, new methods and new prices. Never before have such practical, dependable, and accurate tools been available for so little money. Same Boice-Crane quality—same workmanship—but NEW LOW PRICES.

DRASTIC PRICE REDUCTIONS

11" Ball Bearing Lathe now only $25; 6" Ball Bearing Jointer was $75, now $50; Tilting Arbor Saw was $32.50, now $28.85; Large Top Tilting Arbor Saw was $55, now $41.85. Other machines reduced accordingly. Write for new Price Correction Sheet today.

Job for job, the Boice-Crane Tilting Arbor Saw wins out over tilting table saws every time. Bulletin #700 describes and illustrates the advantages of sawing on a Tilting Arbor Saw. Read this bulletin before buying any saw!

LATEST TILTING ARBOR SAW

WHY A TILTING ARBOR SAW?

The best and newest mill type saws use the tilting arbor principle. Why? Saws costing $1,000 and more have tilting arbors. Why? Is this principle really superior to the tilting table? Is the Boice-Crane Tilting and Lowering Arbor Saw safer, more accurate, and more versatile than a Tilting Table Saw? These and many other questions are answered in Bulletin #700. It's FREE. Write for it.

A COMPLETE LINE. Saw tables—Jointers—Lathes—Band Saws—Jig Saws—Sanders—Shapers. If you deal with a hardware or machinery dealer, insist upon seeing the new Boice-Crane Models before you buy ANY machines. If you have old machines and want to trade for new up-to-the-minute models, write for liberal trade in allowance.

Sold on easy payments—satisfaction guaranteed.

NEW LOW PRICES

NEW JIG SAW 24"x5"

Special table for puzzle sawing.

Adjustable tension with quick release.

Sliding head for long or short blades.

Drip-proof upper plunger bearings.

Table slides back to make blade changing easy. Table and sliding head may be turned 90° to operate like a band saw.

***NEW* 10" JIG SAW**

$4.50

Sturdy cast iron frame. Spring tension. Takes finest blades. Wonderful for puzzle sawing.

FREE CATALOGUE!

W. & J. BOICE, TOLEDO, O.

Please send me: Dept. PS-2J

☐ Catalogue with Jig Saw Bulletin.
☐ Saw Bulletin #700. Tells why a Tilting Arbor Saw is best for my work.
☐ Sheet of new low prices for catalogue F.

Secrets of Success

STORIES THAT WILL HELP YOU GET AHEAD

How you can get into Broadcasting

FLOYD GIBBONS
Famous Radio Broadcaster

BROADCASTING offers remarkable opportunities to talented men and women—if they are trained in Broadcasting technique. It isn't necessary to be a "star" to make good money in Broadcasting. There are hundreds of people in Broadcasting work who are practically unknown—yet they easily make $3000 to $5000 a year while, of course, the "stars" often make $15,000 to $50,000 a year.

An amazing new method of practical training, developed by Floyd Gibbons, one of America's outstanding broadcasters, fits talented people for big pay Broadcasting jobs. If you have a good speaking voice, can sing, act, write, direct or sell, the Floyd Gibbons School will train you—right in your own home in your spare time—for the job you want.

Get your share of the millions advertisers spend in Broadcasting every year. Our free book, "How to Find Your Place in Broadcasting" tells you the whole fascinating story of the Floyd Gibbons Course—how to prepare for a good position in Broadcasting—and how to turn your hidden talents into money. Here is *your* chance to fill an important role in one of the most glamorous, powerful industries in the world. Send the coupon today for free book.

Floyd Gibbons School of Broadcasting,
2000 14th St. N. W., Dept. 3B51, Washington, D. C.

Without obligation send me your free booklet "How to Find Your Place in Broadcasting" and full particulars of your home study Course.

Name ..... Age .....
Please Print or Write Name plainly

Address .....

City ..... State .....

Train for ELECTRICITY IN 12 WEEKS AT COYNE

The great Coyne Shops in Chicago have a world-wide reputation for training men here in Chicago in this big-pay field in only 12 weeks. Then they get behind you to assure success by giving you lifetime employment service. By my new plan YOU can take advantage of their wonderful method of learning-by-doing NOW—no need to lose time and money while you strive and save to raise the necessary tuition.

I WILL FINANCE YOUR TRAINING

Come to Coyne at once. Get your training. Then start paying me for your training a full two months after you graduate, and take a full ten months to complete your payments. If you will write to me at once I will send you complete details of this sensational new plan, together with the BIG FREE illustrated Book telling all about COYNE and how many earn while learning and the training you can get there without book study or useless theory.

H. C. Lewis
President

SEND NOW FOR FULL DETAILS!

Mr. H. C. Lewis, President,
Dept. 23-73, 500 S. Paulina St., Chicago, Ill.

Tell me how you will finance my training at COYNE and send me the BIG FREE illustrated book on ELECTRICITY.

NAME.....

ADDRESS.....

CITY.....STATE.....

ELECTRICAL ENGINEERING

A CONCISE, comprehensive course for men of limited time, complete in one year. Mathematics, engineering drawing, shop-work. Students construct motors, install wiring, test electrical machinery. Modern buildings. 39 years' successful experience. Catalog on request.

BLISS ELECTRICAL SCHOOL
102 Takoma Ave., Washington, D. C.

DEPRESSION PUT HIM ON ROAD TO SUCCESS

I HAVE not had a job for twenty-two months. That may be a funny way to start a Success Story, but it's the best way in my case, because it was this long period of unemployment that made me take stock of my assets and set myself on the right road.

Three months ago my savings had reached a low point. After careful consideration I risked my last savings to buy the necessary machines and supplies, and began the manufacture of jigsaw puzzles in the kitchen workshop of my two-room "apartment."

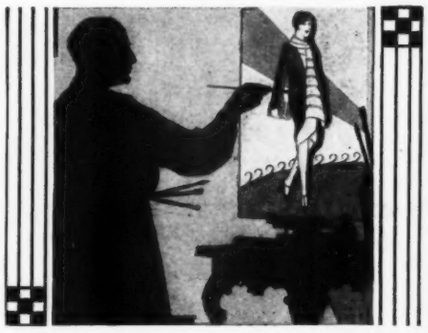
My first customer was a neighbor who had been renting picture puzzles from a library for several months. After completing ten puzzles I interviewed the proprietor of a busy little library. This lady agreed to try them out on a 50-50 rental basis.

When several more puzzles had been completed I called upon another lady who operates a string of libraries and rents puzzles from three of them. She was immediately interested in my product and ordered six 350-piece puzzles from me. She also asked me to make pieces to replace those which had become lost in order that the puzzles might again become money earners. Her next order was for four, larger sized puzzles.

IN THE meantime I was renting new puzzles, as they were finished, to my one customer and then placing them in the rent string of the first library. At present I have 22 puzzles in this string, and they are earning several dollars per week for me. I have more orders from the other library and have found another customer for the replacement pieces. I introduced "Hidden Name" greeting cards to the buyer of a large book and stationery store and five orders were taken before the end of October. I have arranged to make 100 piece puzzles from photographs for a portrait photographer in a large department store.

Now I cannot handle the volume of work by myself. I have been forced to expand, and have rented space in the back end of a cleaning establishment. I have plenty of room for my workshop, and am allowed a front window in which to advertise the puzzle renting service I am starting.

Two friends who have been hard hit by the depression have decided to take a chance with me. We have rented housekeeping rooms *(Continued on page 91)*



ARTISTS EARN MORE

Through art training you may find the way to a large income. Many successful students of the Federal School of Illustrating are now earning from $2500 to $6000 a year and many are making even more. Through the Federal Course more than fifty famous artists—making big money themselves—give you their drawing secrets. In your spare time at home you may learn their methods of Illustrating, Cartooning, Lettering, Poster Designing, Window Card Illustrating, etc.

Learn to "mint" your art talent through Federal Training. Send us your name, age, occupation and address and we will send our Book, "A Road to Bigger Things," and Vocational Art Test without obligation.

FEDERAL SCHOOL of ILLUSTRATING
2143 Federal Schools Building
Minneapolis, : : Minnesota

Drafting and Design

Good pay, steady work, advancement to best-paid positions in Engineering, Building, Manufacturing. Practical home-study training, largely of college standard, includes actual practice in drafting and design. Texts written by 100 authorities; used by resident colleges, trade schools, U. S. Navy, etc.

Well-paid Positions

School chartered 35 years ago as educational institution, not for profit, like best resident colleges. Write today for Free Bulletin, list of local students and graduates. No obligation.

American School, Dept. D-248
Drexel Ave. at 58th St., Chicago

THE UNIVERSITY OF THE HOME

How To Secure A Government Position

Why worry about strikes, layoffs, hard times? Train now for a Government job in the future! Increased salaries, steady work, travel, good pay. Open to citizens 18 to 50. Let me help you become a Railway Postal Clerk, Post Office Clerk, City Mail Carrier, Rural Carrier,—or help you get into any other Government job you want. I was a Secretary Examiner of Civil Service Commission for 8 years. Have helped thousands.

Now FREE My 32-page book tells about the jobs open—and how I can help you get one. Send the coupon for your copy today.

A. R. PATTERSON, Civil Service Expert,
PATTERSON SCHOOL, 162 Wisner Bldg., Rochester, N. Y.

Please send me, without obligation, your free book, "How to Secure a Government Position."

Name.....

Address.....

TRI-STATE COLLEGE

DEGREE IN 2 YEARS

School of Engineering

49th Year

B.S. Degree in Civil, Electrical, Mechanical, Chemical, Aeronautical Engineering in 2 years. Those who lack high school may make up work. Living costs, tuition low. Students from all over the world. *Write for catalog.*

523 College Ave., Angola, Ind.

Secrets of Success

DEPRESSION PUT HIM ON ROAD TO SUCCESS

(Continued from page 90)

nearby. One partner will attend to the cooking, shopping, bookkeeping and make deliveries and run errands. Two will do the actual manufacturing.

I have invested less than $200. and there is sufficient stock on hand to manufacture several hundred puzzles. Rent is paid a month ahead. I have taken in $60. in cash and there are orders enough to keep us busy for the next three months.

I am not yet rich. It will be a problem to exist until the business becomes self-supporting. But prospects are bright. Three people are removed from the ranks of the unemployed. We are using plywood, paper boxes, sheet pictures, saws and machinery; putting money in circulation.

The project has the earmarks of modest success.—W. L. F., San Francisco, Calif.

• • •

HE LEFT DITCH DIGGING TO BE A WATCHMAKER

AFTER I finished public school I was forced to look for a job. For three years I worked as a news butcher on trains, but I knew this was the wrong place for me. The longer I worked the further away I traveled from the road to success.

Actually I wasn't quite sure of just what I wanted. Somehow, I drifted into railroading, working with a construction gang on a line out of St. Louis. I put in four years of back-breaking labor on that job, and finally it became so irksome and hopeless that I decided there must surely be something more pleasant in life for me.

I always enjoyed tinkering around with delicate mechanisms, and the thought struck me that perhaps I could make good as a jeweler. Being fatherless, I consulted my older brother. He discouraged me greatly, saying that any money spent in learning a trade like that would probably be thrown away. The occupations he suggested did not appeal to me.

Though depressed by his words, I found the determination to become a jeweler growing stronger within me every day. I was married and living in Atlanta, Georgia, at the time. I applied to several jewelers in that city for a position as apprentice, so that I might learn the trade. All I did learn was that no one wanted to be bothered training a new man. Refusing to be discouraged, I decided to get that training by myself. *(Continued on page 92)*

So you're going BACK TO WORK!

THAT'S FINE! And more good news is that improved business conditions are sending thousands of other men back to their old jobs or to new jobs.

But don't let your enthusiasm dim the facts. *Business today, and from now on, has a new standard of service.* It is a standard of efficiency—*of training*—and to ignore it is inviting another long stretch of unemployment.

For your own sake, man, for your family's sake, do not flirt with this disaster!

Especially foolish when you can acquire so easily the training you must have . . . when you can make yourself more valuable on your job by devoting a small portion of your spare time to study. In years past millions of men have come to International Correspondence Schools for this training. Today, with its unusual conditions, is bringing many of these men back for *additional* training, to meet and solve the problems of a new day—and many thousands who have decided to face the facts and assure their own futures. Will you face the facts? Do you want to assure your future? Then this coupon is a challenge to you! Why not mark and mail it—right now? If desired, you can arrange to complete the course of your choice through easy monthly payments. Write for full information today.

INTERNATIONAL CORRESPONDENCE SCHOOLS

"The Universal University" BOX 7635-G, SCRANTON, PENNA.

★ Without cost or obligation, please send me a copy of your booklet, "Who Wins and Why," and full particulars about the subject *before* which I have marked X: ★

TECHNICAL AND INDUSTRIAL COURSES

☐ Architect	☐ Telephone Work	☐ Heating ☐ Ventilation	☐ Highway Engineering
☐ Architectural Draftsman	☐ Mechanical Engineer	☐ Sheet Metal Worker	☐ Chemistry ☐ Pharmacy
☐ Building Estimating	☐ Mechanical Draftsman	☐ Steam Engineer	☐ Coal Mining Engineer
☐ Wood Millworking	☐ Machinist ☐ Toolmaker	☐ Steam Electric Engineer	☐ Navigation
☐ Contractor and Builder	☐ Patternmaker	☐ Civil Engineer	☐ Boilermaker
☐ Structural Draftsman	☐ Pipefitter ☐ Tinsmith	☐ Surveying and Mapping	☐ Textile Overseer or Supt.
☐ Structural Engineer	☐ Bridge Engineer	☐ Refrigeration	☐ Cotton Manufacturing
☐ Electric Wiring	☐ Bridge and Building Foreman	☐ R. R. Locomotives	☐ Woolen Manufacturing
☐ Electrical Engineer	☐ Gas Engines	☐ R. R. Section Foreman	☐ Agriculture
☐ Electric Lighting	☐ Diesel Engines	☐ R. R. Bridge and Building Foreman	☐ Fruit Growing
☐ Welding, Electric and Gas	☐ Aviation Engines	☐ Air Brakes	☐ Poultry Farming
☐ Reading Shop Blueprints	☐ Automobile Mechanic	☐ Train Operation	☐ Radio
☐ Telegraph Engineer	☐ Plumbing ☐ Steam Fitting		☐ Marine Engineer

BUSINESS TRAINING COURSES

☐ Business Management	☐ C. P. Accountant	☐ Business Correspondence	☐ Railway Mail Clerk
☐ Office Management	☐ Bookkeeping	☐ Lettering Show Cards	☐ Grade School Subjects
☐ Industrial Management	☐ Secretarial Work	☐ Signs	☐ High School Subjects
☐ Personnel Management	☐ Spanish	☐ Stenography and Typing	☐ College Preparatory
☐ Traffic Management	☐ French	☐ Complete Commercial	☐ Illustrating
☐ Accountancy	☐ Salesmanship	☐ Civil Service	☐ Cartooning
☐ Cost Accountant	☐ Advertising	☐ Mail Carrier	☐ Lumber Dealer

Name..... *Age*..... *Address*.....

City..... *State*..... *Occupation*.....

If you reside in Canada, send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

One Year From Today
—What Will You Be Earning?

THIS may be the most important year in your life! Your whole future is apt to depend on how you take advantage of present business changes. For months—maybe years—companies will be able to choose whomever they want, out of the millions now unemployed or dissatisfied with their work and pay. Naturally they will pick the men with most ability.

You should make yourself more valuable now—not only to protect what you have, but to win promotions, to make up salary cuts. It is being done by OTHERS—It can be done by YOU.

YES—Pay-raises—TODAY!

Hundreds of LaSalle-trained men and women are reporting pay raises and advancement right now. They are beating the depression and insuring the future. Ask us for our new free booklet, "100 Pay Raises Today"—showing what they are doing and what you can do.

Ask us also to send you full details about our new spare-time training, and to explain how it prepares you to meet today's demands and opportunities, also about our salary-increasing plan. If you really are in earnest, you should investigate *at once*. Check your subject below, write your name and address, and *mail*.

LaSALLE EXTENSION UNIVERSITY

Dept. 283-R **CHICAGO**

Send me, free, your new pamphlet, "100 Pay Raises Today," and details of your training plan in the business field checked:

- ☐ Higher Accountancy
- ☐ Expert Bookkeeping
- ☐ Business Management
- ☐ Traffic Management
- ☐ C. P. A. Coaching
- ☐ Grocery Store Management
- ☐ Modern Salesmanship
- ☐ Industrial Management
- ☐ Modern Foremanship
- ☐ Business English
- ☐ Law—LL. B. Degree
- ☐ Commercial Law
- ☐ Stenotypy
- ☐ Effective Speaking

Name.....

Present Position.....

Address.....

LEARN in CALIFORNIA

TELEVISION-RADIO TALKING PICTURES

In just a few years, Radio has become one of the world's leading industries. Talking pictures have brought new life and opportunity to the Movies. Now, Television is here with a promise of growth and activity so great it cannot be estimated. Come to Los Angeles and learn these fascinating Trades.

BUT—You Must Be Trained

Times are getting better. The worst of the depression is over. Thousands of new jobs will call for TRAINED MEN. Will you be ready? Regardless of the times, the Trained man wins. He always has and he always will. Take that fact as a guide and your future is assured.

Special New Course—Radio Broadcast Technician

Special course given to students who enroll immediately. We broadcast over our own station and also by remote control.

EARN Room and Board

75% of our students are earning their living expenses while attending school now. We help you get a job to pay living expenses while learning. If you are short of money, write and explain your problem. We also allow your Coach Railroad Fare to Los Angeles.

Send for FREE BOOK

You will find the facilities here a positive revelation. Get our new book, which gives you all the facts, no obligation—SEND COUPON AT ONCE.

NATIONAL RADIO & ELECTRICAL SCHOOL · *Los Angeles*

Dept. PS2, 4006 So. Figueroa St.
Send Book and full details of Courses.

NAME.....

ADDRESS.....

CITY.....STATE.....

EARN MONEY AT HOME

YOU can make $15 to $50 weekly in spare or full time at home coloring photographs. No experience needed. No canvassing. We instruct you by our new simple Photo-Color process and supply you with work. Write for particulars and Free Book to-day.

The IRVING-VANCE COMPANY Ltd.
315 Hart Building, Toronto, Can.

Secrets of Success

HE LEFT DITCH DIGGING TO BE A WATCHMAKER

(Continued from page 91)

Searching the advertising sections of magazines appealing to mechanically inclined men, I found that a course in watchmaking and repairing was offered by a well-known correspondence school at a comparatively low cost. Here was a chance to learn while holding my own job. My wife was dead set against the idea, saying that it was just a notion of mine and that I would probably drop out before finishing the course, and so lose everything.

But my confidence was stronger than her arguments and I went ahead with my plans. I look back on the months that came afterward as a period when I worked harder than ever before or since. Day after day, I labored at digging ditches. Night after night, long after the family was asleep, I sat up in a small back room and studied. Luckily, I was so greatly fascinated that I never thought of it as work. I finished the course in 1930, when the depression started, and so, when I told the boss of my gang I was quitting he thought I was crazy.

We moved back to my home town, and what little capital was left went into the watchmaking business. Two years have passed and I'm still at it; not making a fortune, but managing to make a living and to keep ahead of expenses. This can't be called a great financial success, but it is a success in so far as I am happy at my present work, keeping my head above water—and looking for better days when things become more normal. I'd have no such outlook if I were still digging ditches.—C. L. B., Camden, Tenn.

Cash Prizes

THIS department will give $5.00 for every true success story submitted by readers of Popular Science Monthly, and which is accepted for printing in this magazine.

Manuscripts will be judged on the individual merits of the case and circumstances involved. Only stories in which the author's success, or that of some one known to the author, has been gained by some method of educational guidance, fitness for the job, or application to the work will be considered. We are not looking for the "get-rich-quick" type of story.

Manuscripts must be confined to 500 words or less. They must be true and, if accepted, authors must be prepared to give us signed statements to the effect that they are true. Manuscripts submitted and printed become the property of this magazine, and we are not responsible for the return of rejected stories unless postage is provided for this purpose. Address contributions to Success Story Department, Popular Science Monthly, 381 4th Avenue, New York City.

LEARN AVIATION

Prepare Yourself Now for a Good Pay Job

in Aviation, the world's fastest growing industry.

LEARN AT LINCOLN, the world's best known aviation school. Here we give you complete, thorough training that wins high recognition for our graduates throughout the world. Both ground and flying school Government Approved. Government Licensed Instructors. Unexcelled equipment.

A new era is dawning for mechanics and pilots. Big pay opportunities both in U. S. and foreign countries, especially in Central and South America. We have representatives and students in 25 foreign countries, as well as students in every state in the Union. Aviation courses taught in either Spanish or English. Come to Lincoln and be sure of a successful career in aviation.

Write today for full particulars . . . stating age.

Lincoln Airplane & Flying School
216B Aircraft Bldg. Lincoln, Nebraska

FUN!

MAKE THIS Squirrel Lamp

Yes sir, out of a real squirrel! Also make ash-trays, book-ends, etc., using rabbits, frogs, etc. LEARN AT HOME TO MOUNT BIRDS, ANIMALS & FISH; tan skins and make rugs. Decorate your room.

It's FUN! BIG profits in spare time!

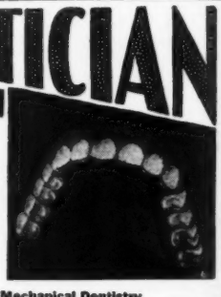
Free book tells how.

FREE BOOK! Write TODAY for beautiful free book telling how to learn this fine hobby. Book is free. Contains many fine pictures. STATE YOUR AGE.

N. W. SCHOOL OF TAXIDERMY, Dept. 3392 Omaha, Nebr.

Be a DENTICIAN

LEARN AT HOME



To make Crowns, Plates, Bridgework, etc., for Dentists. Easy practical way to learn mechanical dentistry at home in spare time. **FULL EQUIPMENT OF TOOLS AND MATERIALS INCLUDED WITH COURSE** FREE. Low tuition. Easy terms. Write for FREE BOOK about this money making profession and our easy-to-learn home study course and special offer.

McCarrie School of Mechanical Dentistry
316 S. Wabash Avenue Dept. E-517 Chicago, Ill.

Mysterious Power of Pelmanism

Let us send you a free copy of "Scientific Mind Training." An instructive book which explains an amazing system of mind training already used by more than 750,000 people. It will show you how and why Pelmanism is the *only* system of teaching for developing *all* the mental powers at the same time. Endorsed by such world leaders as Frank P. Walsh, Edgar Wallace, Sir Harry Lauder, Prince Charles of Sweden and hundreds of others. Write TODAY to

THE PELMAN INSTITUTE OF AMERICA
271 NORTH AVENUE, DEPT. 872, NEW ROCHELLE, N.Y.

MAKE MORE MONEY IN PHOTOGRAPHY

Learn quickly in your own home at low cost. Same practical training, given by same expert instructors who handle personal attendance coaching in our completely equipped studios. Only home-study training offering this advantage. You may earn while learning. FREE placement service. . . BOOKLET, NO COST.

☐ Still Photography (Commercial, News, Portrait) and Photo-Finishing
☐ Motion Picture Photography and Projection

NEW YORK INSTITUTE OF PHOTOGRAPHY
10 W. 33rd Dept. 5 B New York

STEP INTO A WELL-PAID HOTEL JOB

Hotels call for trained men. Good pay, fascinating work, unlimited opportunities for advancement. Qualify in spare time. Previous experience unnecessary. Placement Service FREE of extra charge. FREE book gives details.

$1800 TO $5000 A YEAR

LEWIS HOTEL TRAINING SCHOOLS
Room GB-2790 Washington, D. C.

New York Electrical School

Established 1902

Ask for free booklet

40 West 17th St., N. Y. C.

BATTLESHIP *TEXAS*

(Continued from page 89)

that the distance along the deck between the after struts and the fiddley is not less than 4 3/16 in. or the guns will not swing.

The emergency boats are kept in davits at the afterdeck. The davits are round, tapered to the end, and about 1½ in. high. They are set into sockets on the armor plate and are supported by brackets from the deck as shown in detail *65*. The sockets are pieces of tube soldered to plates, the latter being drilled as shown for nails. The brackets, which extend some way out to keep the davits vertical, are brass plates drilled for nails. The boats are navy whaleboats. They should have a few oars in each and be hung with two double blocks as small as you can make them. All are gray except the oars. They are usually kept swung out, but they are less likely to be damaged if swung in.

THE seaplane is shown in detail *13*. The fuselage is cut from a piece of ¼-in. dowel, the wings from 1/16-in. plywood, fiber board, or brass. Holes are drilled through both for the struts, but nailing them to the fuselage is what really holds them. The propeller is cut from wood or brass and fastened with a pin. Four struts (brass wire) come from the fuselage to hold the pontoon. Side pontoons are omitted. The tail is brass or cardboard nailed on, and the rudder is the same. The ship's name should be lettered on the sides, and the tail painted red, white, and blue, the red being forward. The plane rests on a carriage running on the catapult, and the catapult is set on a round turntable on the third turret, as shown.

The full armament of the *Texas* consists of:

Ten 14-in. 45-cal. guns in turrets, mark I; twelve 5-in. 51-cal. rapid-fire guns, mark VII; six 3-in. anti-aircraft guns, mark III; three 3-pounder saluting guns, 50-cal. (length 99 in.); two 1-pounder semiautomatic guns (length 30 in.); two 3-in. 23.5-cal. landing guns.

The "caliber" of a gun is the diameter of the bore at the muzzle. Thus a 14-in. gun will have a bore of 14 in. The designation "45 caliber" denotes that a gun is 45 times its caliber in length, or in the case of a 14-in. gun, 52 ft. 6 in., to which is added the breech. The "mark" is the design, or modification from the original "mark I."

OUR 14-in. guns will be 3½ in. long by 3/16 in. (full) diameter at the breech, with 2¼ in. projecting from the turrets. All ten of them are mounted two to a turret.

The guns can be cut or turned from wood or brass. Note that the muzzles have only a slight flare (see *57*).

The turrets *(9)* should be cut to the shape shown. The holes for the guns must be carefully made halfway up the turrets so that the guns will be horizontal and parallel. Any divergence will look bad, and all the guns must project the same amount.

These turrets rest on the barbettes, three of which *(7)* are low, and two *(8)* considerably higher. The barbettes should be turned or *(Continued on page 95)*

I will train you at home to fill a BIG PAY Radio Job

J. E. Smith, President, National Radio Institute, the man who has directed the Home Study Training of more men for the Radio industry than any other man in America.

Free Book Tells How Mail Coupon!

If you are dissatisfied with your present job, if you are struggling along in a rut with little or no prospect of anything better than a skinny pay envelope—clip the coupon NOW. Get my big FREE book on the opportunities in *Radio*. Read how quickly you can learn at home in your spare time to be a Radio Expert—what good jobs my graduates have been getting—real jobs with real futures.

Many Radio Experts Make $50 to $100 a Week

In about ten years the Radio Industry has grown from $2,000,000 to hundreds of millions of dollars. Over 300,000 jobs have been created by this growth, and thousands more will be created by its continued development. Many men and young men with the right training—the kind of training I give you in the N. R. I. course—have stepped into Radio at two and three times their former salaries.

Get Ready Now for Jobs Like These

Broadcasting stations use engineers, operators, station managers, and pay up to $5,000 a year. Manufacturers continually employ testers, inspectors, foremen, engineers, service men, buyers, for jobs paying up to $6,000 a year. Radio Operators on ships enjoy life, see the world, with board and lodging free, and get good pay besides. Dealers and jobbers employ service men, salesmen, buyers, managers, and pay up to $100 a week. My book tells you about these and many other kinds of interesting Radio jobs.

Many Make $5, $10, $15 a Week Extra in Spare Time, Almost at Once

The day you enroll with me I send you material which you should master quickly for doing 28 jobs common in most every neighborhood, for spare-time money. Throughout your course I send you information on servicing popular makes of sets! I give you the plans and ideas that have made $200 to $1,000 a year for N. R. I. men in their spare time. My course is famous as the course that pays for itself.

Here's Proof

Jumped from $35 to $100 a week

"Before I entered Radio I was making $35 a week. I earned $100 in one week servicing and selling Radios. I owe my success to N. R. I. You started me off on the right foot."
J. A. VAUGHN, Grand Radio & App. Co., 3107 S. Grand Blvd., St. Louis, Mo.

$500 extra in 6 months

"In looking over my records I find I made $500 in my spare time in six months. My best week brought me $107. I have only one regret regarding your course—I should have taken it long ago."
HOYT MOORE, R. R. 2, Box 919, Indianapolis, Ind.

Television, Short Wave, Talking Movies. Money-Back Agreement Included

Special training in Talking Movies, Television, and Home Television experiments, Short Wave Radio, Radio's use in Aviation, Servicing and Merchandising Sets, Broadcasting, Commercial and Ship Stations are included. I am so sure that N.R.I. can train you satisfactorily that I will agree in writing to refund every penny of your tuition if you are not satisfied with my Lesson and Instruction Service upon completion.

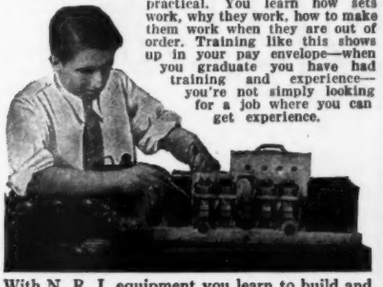
64-Page Book of Information FREE

Get your copy today. It's free to all residents of the United States and Canada over 15 years old. It tells you where Radio's good jobs are, what they pay, tells you about my course, what others who have taken it are doing and making. Find out what Radio offers you without the slightest obligation. ACT NOW!

J. E. SMITH, Pres.
National Radio Institute
Dept. 3BP3
Washington, D.C.

SPECIAL Radio Equipment for Broad Practical Experience *Given Without Extra Charge*

My Course is not all theory. I'll show you how to use my special Radio Equipment for conducting experiments and building circuits which illustrate important principles used in such well known sets as Westinghouse, General Electric, Philco, R. C. A., Victor, Majestic, and others. You work out with your own hands many of the things you read in our lesson books. This 50-50 method of training makes learning at home easy, interesting, fascinating, intensely practical. You learn how sets work, why they work, how to make them work when they are out of order. Training like this shows up in your pay envelope—when you graduate you have had training and experience—you're not simply looking for a job where you can get experience.



With N. R. I. equipment you learn to build and thoroughly understand set testing equipment—you can use N. R. I. equipment in your spare time service work for extra money.

I have doubled and tripled the salaries of many. Find out about this tested way to BIGGER PAY

Get a Job with a Future

FILL OUT AND MAIL THIS COUPON TODAY

J. E. SMITH, President
National Radio Institute, Dept. 3BP3
Washington, D. C.

Dear Mr. Smith: Without obligating me, send free book about spare time and full time Radio opportunities and how I can train for them at home.

NAME.....

ADDRESS.....

CITY.....STATE.....

THE FAMOUS COURSE THAT PAYS FOR ITSELF

CHEMISTRY

Complete, practical home-study courses prepared by some of the best-known chemists in this country, including ALLEN ROGERS, B.S., M.S., Ph.D.—Head of Department of Industrial Chemistry, Pratt Institute; L. M. TOLMAN, Ph.D., Vice-president United Chemical and Organic Products Co.; BRADLEY STOUGHTON, B.S.—Head of the Department of Metallurgy, Lehigh University, and OWEN L. SHINN, Ph.D.—Professor of Applied Chemistry, University of Pennsylvania.

Mail Coupon for Free Booklet

INTERNATIONAL SCHOOL OF CHEMISTRY
Division of the
International Correspondence Schools
Box 7636-G, Scranton, Penna.

Without cost or obligation, please send me full details of your home-study course in

☐ Analytical Chemistry ☐ Metallurgical Chemistry
☐ Chemical Engineering ☐ Short Chemistry Course
☐ Industrial Chemistry ☐ Pharmacy

Name.....

Address.....

Learn Radio in 10 Weeks PAY for TRAINING AFTER YOU GRADUATE!

GET DETAILS OF MY AMAZING OFFER!

Prepare for jobs in Radio Broadcast, Talking Pictures, Television, **by ten weeks of practical shop work** in the great Coyne Radio Shops, on real machinery and equipment. You don't need advanced education or experience. Free Employment Service for life. **Many earn while learning. Mail coupon today** for free book which tells you how hundreds of others have become successful Radio men after taking my training.

COYNE RADIO SCHOOL, H. C. LEWIS, Pres.
500 S. Paulina Street, Dept. 23-4H. Chicago, Ill.

Send Free Radio Book and facts. **Tell how I can pay for my course on easy payment plan after I graduate.**

Name.....

Address.....

Town..... *State*.....

BIG PAY DIESEL JOBS

MEN NEEDED To operate DIESEL—
Trucks
Busses
Power Plants
Marine Engines
Locomotives
Airplanes
Power Shovels
Tractors
Ice Plants
Mining Plants
Pumping Plants
Many Other Opportunities

The Hemphill **Home Study Course** which includes **Practical Shop Training** in the famous Hemphill Schools prepares **You** for **Big Pay** Diesel jobs—employers depend on us for Diesel Engineers. You learn quickly. Many successful graduates. Write **Today** for our **Free** illustrated booklet, **"Big Pay Diesel Opportunities.**

HEMPHILL DIESEL ENGINEERING SCHOOLS
2102 San Fernando Rd., Los Angeles, Cal.
503 Westlake North, Seattle, Washington

Learn Advertising at Home

Make money in advertising. Prepare quickly during spare time. Also earn while you learn. No experience necessary. New easy method. Nothing else like it. Send at once for free booklet—"Win Success in Advertising", and full particulars. No obligation.

Page-Davis School of Advertising
3601 Michigan Ave., Dept. 1362, Chicago, U. S. A.

REAL JOBS OPEN

For Trained Auto Mechanics

Step into big pay. Earn $35 to $70 a week. I train you in only 8 weeks at largest school of its kind in world. New practical shop plan. Learn with real tools . . . on real equipment. Write quick for Big Free Auto Book and Special Low Tuition offer. No obligation. Add. J. H. McSweeny.

FREE BOOK

McSWEENY SCHOOL, Dept. A-6-2, Cleveland, Ohio

BE A RAILWAY TRAFFIC INSPECTOR

RAILWAYS AND BUS--STEADY PAY PLUS EXPENSES

ACTIVE MEN--19 to 55--needed at once for *Passenger Traffic Inspection*. Rapid pay advances after a few months' experience. S.B. T.I. men also become executives. Interesting, outdoor work--travel or remain near home. We'll train you for this uncrowded profession and on completion of a few weeks' home study place you at $120 to $150 per month up (plus expenses) to start, or refund tuition. Free Booklet tells about this opportunity in the field of Transportation. **Standard Business Training Institute, Div. 302, Buffalo, N. Y.**

HOME WORKSHOP BLUEPRINTS

New projects are marked with an asterisk (*)

TO ASSIST you in your home workshop, POPULAR SCIENCE MONTHLY offers large blueprints containing working drawings of a number of well-tested projects. The blueprints are 15 by 22 in. and are sold for 25 cents a single sheet (except in a few special cases). Order by number. The numbers are given in italic type and follow the titles. When two or more numbers follow one title, it means that there are two or more blueprints in the complete set. If the letter "R" follows a number, it indicates that the blueprint or set of blueprints is accompanied by a special reprint of the instructions originally published in the magazine. If you do not wish this reprint, omit the letter "R" from your order and deduct 25 cents from the price given. Reprints alone are sold for 25 cents each.

Flying Airplane Models

Bremen (Junkers, 3-ft. Flying), *89-90*	$ .50
Lindbergh's Monoplane (3-ft. Flying), *69*	.25
Nieuport XVII (29-in. flying), *180-181*	.50
Rise-off-Ground Tractor, 3-ft., *50*	.25
Seaplane, Tractor, 30-in., *87*	.25
Seaplane, Morris (Record 12½ min.), *102*	.25
S. E. 5a World War Plane (30-in.), *168-169*	.50
Single Stick, Tractor, 30-in., *82*	.25
Tractor (Record Flight 6,024 Ft.), *104*	.25
Twin Pusher, Racing, 35-in., *86*	.25
Winnie Mae (4-ft. flying), *141-142-143*	.75

Boats

Canoe, Sailing Outfit, *25*	.25
Canoe, 16-ft. Canvas Covered Kayak, with Sail, etc., *192-193-194-R*	1.00
With full size patterns	2.50
Duck Boat, Folding, *170-R*	.50
With full size patterns	2.00
Outboard Racer, 11½-ft., *128-129-R*	.75
With full size patterns	2.25
Sailboat-Motorboat, Combination (15 ft., cat rig), *131-132-133-R*	1.00
With full size patterns	2.50
Marconi Rig with Jib for Above, *133A*	.25
13-ft. Rowboat-Motorboat, *147-R*	.50
With full size patterns	2.00
14½-ft. Rowboat-Motorboat, *148-R*	.50
With full size patterns	2.00
16-ft. Rowboat-Motorboat, *149-R*	.50
With full size patterns	2.00
Stern Drive Installation (When used with Rowboat-Motorboat), *150*	.25
15½-ft. Runabout or "Sportboat" (outboard or inboard motor), *175-176-177-R*	1.00
With full size patterns	2.50

Furniture

Bookcase, Simple, *37*	.25
Bookshelf and Book Ends, Modernistic, *100*	.25
Bookshelves, Hanging, *77*	.25
Bookstand, Modernistic, *88*	.25
Book Trough, *68*	.25
Cedar Chest, Mahogany Trimmed, *17*	.25
Chair, Rush-Bottom, *36*	.25
Chests, Treasure, *78*	.25
Clock, Grandfather, *19*	.25
Desk, Colonial, *21*	.25
End Table, Magazine, *68*	.25
Fireside Bench, Colonial, *187A, 188A*	.50
Kitchen Table Cabinet, *27*	.25
Lamps, Modernistic, *93*	.25
Mirror, Scroll Frame, *105*	.25
Muffin Stand, Folding, *173A-174A*	.75
(See page 84 for kit of materials)	
Pier Cabinet and Corner Shelves, *77*	.25
Radio Cabinet, Console, *70-71*	.50
Screens, Modernistic Folding, *91*	.25
Sewing Cabinets, Two, *31*	.25
Sewing Table, *1*	.25
Shelves and Lamp, Modernistic, *93*	.25
Smoking Cabinet, *2*	.25
Stand, Low Modernistic, *100*	.25
Table, Gate-Leg, *24*	.25
Table, Tavern, *105*	.25
Table, Tilt-Top, Oak (Top 20 by 24 in.) *140*	.25
Tea Wagon, *13*	.25

Radio Sets

Amplifier, Three-Stage, Audio-Frequency, *42*	.25
Five-Tube (Battery Operated), *54-55*	.50
Full Electric Headphone Set, *130*	.25
One Tube (Battery Operated), *103*	.25
Screen-Grid Set, *109*	.25
Short-Wave Converter Unit, *137*	.25
Amateur Short Wave Receiver, *155*	.25
Amateur Radio Transmitter, *183-184*	.50

Ship and Coach Models

Bark, Scenic Half-Model (13½-in.), *108*	.25
*Battleship—U. S. S. *Texas* (3 ft. Hull), *197-198-199-200*	1.00
(See page 84 for kit of materials)	
Bottle, Clipper Ship in, *121-122*	.50
Clipper, Baltimore (8-in.), *92*	.25
Clipper Ship (20½-in. Hull), *51-52-53-R*	1.00
Constitution (21-in. Hull), *57-58-59-R*	1.00
Covered Wagon (23½-in.), *118-119-120-R*	1.00
Destroyer—U. S. S. *Preston* (31½-in. Hull), *125-126-127-R*	1.00
Galleon, Spanish Treasure (24-in.), *46-47*	.50
(See page 84 for kit of materials)	
Mayflower (17½-in. Hull), *83-84-85-R*	1.00
Miniature Coach and Covered Wagon for Decorating Boxes, etc., *202-R*	.50
Motorboat, 29-in. Cruiser, *63-64-R*	.75
Motorboat, Working Scale Model Driven by Rubber Bands or Toy Outboard Motor (20-in. Hull), *196*	.25
*Liner—*Manhattan* (12 in. long), *204*	.25
(See page 84 for kit of materials)	
Pirate Galley or Felucca (20-in.), *44-45-R*	.75
Roman Galley (19-in.), *138-139-R*	.75
Sails—Square and Fore-and-Aft for any Model, *185-186*	.50
Santa Maria (18-in. Hull), *74-75-76-R*	1.00
Schooner — *Bluenose* (17½-in.), *110-111-112-R*	1.00
Sedan Chair, Queen's (12-in.), *123-124*	.50
Stagecoach, Concord (20½-in.), *115-116-117-R*	1.00
Stagecoach (Cody), with Horses (Coach Body 13 in. Long), *144-145-146-R*	1.00
Steamboat, Mississippi (19½-in.), *94-95-96-R*	1.00
Viking Ship (20½-in.), *61-62-R*	.75
Weather Vane, Ship Model (30-in.), *66*	.25
Whaler—*Wanderer* (20½-in.), *151-152-153-154*	1.00
Sails for *Wanderer*, *185-186*	.50
(See page 84 for kit of materials)	
Yacht, *Sea Scout*, 42-in. Racing, *106-107-R*	.75
Yacht, 20-in. Racing, *48-R*	.50

Toys

Airplane Cockpit with Controls, *114*	.25
Birds and Animals, *56*	.25
Doll's House, Colonial, *72*	.25
Drill Press, Lathe, Saw, etc., *113*	.25
Dump Truck, Fire Engine, etc., *101*	.25

Miscellaneous

Log Cabin (Three Rooms), *134-R*	.50
Puzzles, Six Simple Block, *65*	.25
Tool Cabinet, Bench Hook, etc., *30*	.25
Workbench, *15*	.25

Popular Science Monthly
381 Fourth Avenue, New York

Send me the blueprint, or blueprints, numbered as follows:

No..... No..... No..... No.....
No..... No..... No..... No.....

Patterns for .....
Reprints alone for .....
I am inclosing.....dollars.....cents.

Name .....

Street .....

City and State .....

Note: Please print your name and address very clearly. If you do not wish to cut this page, order on a separate sheet.

BATTLESHIP *TEXAS*

(Continued from page 93)

cut round. The second and fourth should be left long, the extra part being turned smaller to fit tightly in holes in the deck. This is because the second contains the motor switch and the fourth should lift off to allow ballast to be placed in the hull to balance it. I built a small box between the propeller shafts to hold the ballast. The amount required will depend upon the distribution of other weights. If it is not a working model, the barbettes can be glued right on the deck. The switch, of course, may be placed somewhere else.

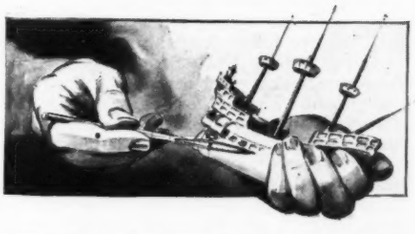
THE guns are put in the turrets, which are fastened with a long nail. Turret No. 3 at least will have to turn, so that the fiddley deck can be lifted off. On this turret the plane catapult is fastened. Turret No. 4 should have a range finder on top to the port side, as should No. 2 if there is no switch in the way, but this one will be to starboard.

On the upper deck there is a 5-in. rapid-fire gun at each side pointing forward. These should be mounted as shown in detail *58*. The other ten 5-in. guns project from casemates in the ship's side, therefore only 13/16 in. of them will project and no mounting is necessary. These guns are shown in the profile plan, detail of the upper deck, and detail *58*. The casemates are marked *15*. They are triangular cuts carved into the side of the hull, in the angles of which are semicircular revolving plates through which the guns project. The guns, when at rest, should be horizontal and parallel to the fore-and-aft line of the ship. Forward there are three similar casemates *(16)*, but the guns have been removed from these and windows put in the first, ports in the second, and nothing in the third—under the bridge.

The small guns, with the exception of four anti-aircraft guns have been omitted. They would go on the first bridge deck, and the field guns would be lashed on the afterdeck. I put an anti-aircraft gun *(59)* in each wing of deck *29*, and one on each wing of the upper deck *17*.

The remaining details will be described next month in the final article of the series.

OLD RULING PEN AIDS IN MODEL MAKING



FOR fastening wire parts to an extremely small ship model, I utilized a discarded ruling pen of the type used by draftsmen. Unlike tweezers, the ruling pen can be clamped on the wire or other small part, thus allowing it to be held firmly in until the glue has set.—FRANK E. CRANE, JR.

I WISH I HAD SOME SPENDING MONEY
HERE'S MY CHANCE! I'LL MAIL THE COUPON!
BRING A "COMPANION" EVERY MONTH
NOW I HAVE MONEY AND A BICYCLE, BESIDES!

WIN THIS BICYCLE!

It's easy! Earn your own SPENDING MONEY! Get this speedy motorbike—and your choice of 300 other prizes—without a cent of cost. Bike comes to you fully equipped with coaster brake, headlight, and other big features. Built for easy riding, long wear, and speed.

MONEY and PRIZES can be yours for delivering 3 well-known magazines to customers in your neighborhood. Will not interfere with school or play. Mail the coupon—and we'll start you.

MAIL THIS COUPON AT ONCE!

Mr. Jim Thayer, Dept. 293
The Crowell Publishing Co.
Springfield, Ohio

Dear Jim: I want to win MONEY and PRIZES. Start me as a salesman.

Name .....

Address .....

City ..... State.....

New Adding Machine Fits Vest Pocket!

Adds, subtracts, multiplies, and divides like $300 machine—yet it costs only $2.50. Weighs only 4 ounces. Not a toy—guaranteed for lifetime. Perfectly accurate, lightning fast. Sells on sight to business men, storekeepers, homes—all who use figures. Write at once for Free Sample Offer and Money-Making Plan. 100% Profit! AGENTS

C. M. CLEARY, Dept. 056, 303 W. Monroe St., Chicago

IT'S EASY TO MAKE BIG SPARE TIME MONEY

Send for our free plan on how to make $5.00 to $15.00 a week in your spare time by taking orders for POPULAR SCIENCE MONTHLY from your friends. No selling required. Turn extra hours into extra dollars.

POPULAR SCIENCE MONTHLY
381 Fourth Ave. New York, N. Y.

Electrical Engineering

New opportunities constantly opening to men properly trained. Electrical Engineering is still one of the biggest, livest, fastest growing fields. Practical training, largely of college standard, given by home study. Texts written by 28 authorities from General Electric, Westinghouse, Mass. Inst. of Technology, Lehigh, etc.; used by resident colleges, trade schools, U. S. Navy, etc. School chartered 35 years ago as educational institution, not for profit, like best resident colleges. Write today for Bulletin, list of local students and graduates.

American School, Dept. E-248, Drexel at 58 St., Chicago

LAW STUDY AT HOME

Legally trained men win high positions and big success in business and public life. Be independent. Greater opportunities now than ever before. Big corporations are headed by men with legal training. Earn $5,000 to $10,000 Annually

We guide you step by step. You can train at home during spare time. Degree of LL. B. conferred. Successful graduates in every section of the United States. We furnish all text material, including fourteen-volume Law Library. Low cost, easy terms. Get our valuable 64-page "Law Guide" and "Evidence" books FREE. Send for them NOW.

LaSalle Extension University, Dept. 283-L Chicago
The World's Largest Business Training Institution

Print Your Own

Cards, Stationery, Advertising, labels, paper, circulars, tags, etc. Save money and time. Sold direct from factory only. Junior Press $5.00, Job Press, $11. Power $149. Do popular raised printing like engraving with any of our presses. Print for Others, Big Profits. Pays for itself in a short time. Easy rules sent. Write for free catalog of outfits and all details.
The Kelsey Co., H-33, Meriden, Conn.

CARTOON YOUR WAY TO SUCCESS!

DON'T COPY - LEARN TO ORIGINATE!

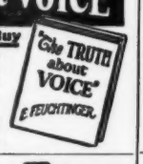
RAYE BURNS will teach you HOW to CREATE ORIGINAL CARTOONS at home that you can SELL! Course has 26 lessons and 600 illustrations. $2.85

Send name and address for free details. Only....

RAYE BURNS SCHOOL, Dept. S-X, Box 2194, Cleveland, Ohio

"The TRUTH about VOICE"

SENT FREE No Obligation to Buy



If you act quick!—we will send postpaid—for 30 days free reading—new Voice Book disclosing startling VOICE FACTS that may save hundreds of dollars to every man or woman seeking a strong, rich voice for either singing or speaking. 30 days free reading—then send $1.00. Otherwise, return it—that's all!
PROF. E. FEUCHTINGER Studio 13-62
308 North Michigan Avenue • Chicago

EARN UP TO $25 A WEEK, OR MORE

Grow Mushrooms in your cellar or shed. Big demand. Experience unnecessary—we tell you how. Illustrated book free. Start NOW—write today.
American Mushroom Industries, Ltd.
Dept. 452 Toronto, Ont.

Wrestling Book FREE

Wrestling taught at home, by mail, by greatest of all world's champions—Farmer Burns and Frank Gotch. Be a wonderful athlete. Handle bigger, stronger men with ease. Learn the secrets of experts. Jiu-Jitsu, Physical Culture. Have perfect health, fame, a perfect body admired by both sexes.
FREE 32 page illustrated prospectus, full of thrilling information, sent free. Tells how we teach expert wrestling at home. Send 2c to cover postage. Write now for your copy. State age.
FARMER BURNS SCHOOL
3392 Courtney Bldg., Omaha, Neb.

Tricks With Electricity

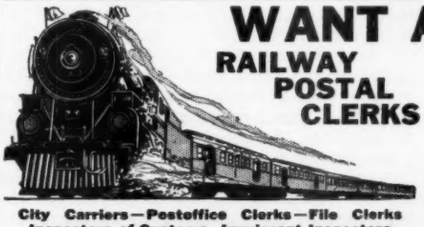
Make things spin, jump, kick, buzz, shoot, shock, flash, mystify—all by electricity. Make lights obey voice, window novelties, trick lights, floating rings, spirit rapping—all kinds amusing, practical devices. Book tells how to do 200 stunts with 110 volts A.C. Postpaid $1. Experimenters catalog free.
CUTTING & SONS, 23 S St., CAMPBELL, CALIF.

WANT A STEADY JOB?

RAILWAY POSTAL CLERKS

$158 to $225 Month

Mail Coupon Before You Lose It



City Carriers—Postoffice Clerks—File Clerks
Inspectors of Customs—Immigrant Inspectors
Hundreds Future Appointments Coming

FRANKLIN INSTITUTE, Dept. F-274, Rochester, N. Y.

Sirs: Rush to me without charge copy of 32-page book, "How to Get U. S. Government Jobs," list of future positions for men—women 18 to 50 and full particulars telling how to get them.

Name .....

Address .....

ACUMEN

The Sharpness of the Mind

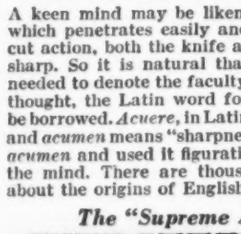
A keen mind may be likened to a sharp knife, which penetrates easily and quickly. For clean-cut action, both the knife and the mind must be sharp. So it is natural that, when a word was needed to denote the faculty of keen, penetrating thought, the Latin word for "sharpness" should be borrowed. *Acuere*, in Latin, means "to sharpen" and *acumen* means "sharpness." English borrowed *acumen* and used it figuratively for sharpness of the mind. There are thousands of such stories about the origins of English words in

The "Supreme Authority"

WEBSTER'S NEW INTERNATIONAL DICTIONARY

A Merriam-Webster

In its **2,700** pages there are **452,000** entries, including thousands of NEW WORDS, **12,000 biographical** entries, **32,000 geographical** subjects, **100 valuable tables,** over **6,000 illustrations.** Its encyclopedic information makes it a general question-answerer on all subjects.



See It at Your Bookstore. Remember: *A Merriam-Webster* appears on the cover of every dictionary for which G. & C. Merriam Company is editorially responsible.

Send for Free Booklet of Word Stories. An unusually interesting illustrated booklet sent free on request.

MAIL THE COUPON

G. & C. MERRIAM CO., Springfield, Mass.

Please send me your free booklet "Interesting Origins of English Words" and full information about Webster's New International Dictionary. (Pop. Sci. 2-33)

Name_____

Street and Number_____

City_____ State_____

Copyright 1933 by G. & C. Merriam Company

Always mention POPULAR SCIENCE MONTHLY when answering advertisements in this magazine.

INVENTORS PATENT YOUR IDEAS

Get this FREE Book

Protect the future profits from your idea by securing a U. S. Patent. Delays are often dangerous. I give prompt and personal attention to your case—nothing is entrusted to unskilled assistants. The Patent Office itself urges you to select a Competent Registered Patent Attorney in order to protect your interests properly. Therefore, before doing anything else, send for my NEW FREE BOOK and get the full facts, and with it I will send you my FREE "Record of Invention" form. All correspondence strictly confidential. *Mail coupon TODAY.*

L. EDWARD FLAHERTY
REGISTERED PATENT ATTORNEY

717 International Building, WASHINGTON, D. C.

Please send immediately your FREE book and Record of Invention Form.

Name_____

Address_____

City_____ State_____

AGENTS SAVE FARMERS FROM CROP SHARKS

(Continued from page 39)

a new idea is concerned, you should observe the actions of the crop-reporting army that must prevent the misuse of its information.

Field representatives relay information, usually by telegraph, back and forth among the various branch offices, so that all parts where such information is of value will be served. It would be almost a physical impossibility to send to Washington for redistribution all of the facts collected.

However, periodic crop information is sent to Washington by field men, and it is this that forms the basis of prices of agricultural products—prices that you pay for many of the things you eat and wear. Reports are surrounded with the greatest secrecy while in the hands of field men, and are transmitted in code or by mail to Washington where they are dropped into a locked mail box at the Secretary of Agriculture's office. Finally they become the basis for a ceremony, most of which takes place behind locked doors.

DATES for crop report releases are fixed by law, and are varied but slightly to accommodate holidays and Sundays. There is one report every month during the crop-growing season, usually during the first ten days. On the appointed day, the chairman of the crop and livestock board, and one other board member, accompanied by a guard, proceed to the Secretary's office. They get the reports, which are in the special mail box in the Secretary's office, and take them to the board rooms—still accompanied by the guard. Once inside the rooms, the doors are locked, and are kept that way until the board report is released.

In the new agricultural building, the crop reporting board meets in a special section that can be closed off from the rest of the building. Here the board members and a corps of some half-hundred statisticians and clerks labor, sometimes throughout the night, until final tabulations have been made. Because the information that is being handled is of almost unbelievable value, extreme precautions are made to prevent leaks. Premature announcements might upset market values the world over, or might be used by speculators for private gain. Even more important than most war secrets, is some of the crop and livestock data. In the past, there have been occasional rumors that information has leaked out, but no serious leak ever has occurred.

TODAY, it would be practically impossible for a clerk or other person in the secret chamber to give out signals that an accomplice outside might pick up and relay to speculators. First, the law prohibits employees concerned with crop reports from speculating in agricultural products, knowingly issuing false information, or giving out information of any kind concerning forthcoming reports. The maximum penalty for violation is a $10,000 fine and a 10-year imprisonment—not a pleasant reward for a bit of dishonest signaling.

However there are precautions taken against leaks. Because every single figure concerning crops or stock is a summary of many other figures from various sources, the final information is not available until a few minutes before issuance of the report. The work of compiling information is arranged so that all final figures for all crops are tabulated at about the same time. Then, in addition to the locked doors, window shutters are locked in a closed position to prevent signaling to outsiders. A special locking bar, sealed in place, is used for this.

As the reports are prepared, they are set up on machines for mimeographing. The Secretary of Agriculture goes to the board rooms fifteen minutes before the release time, and approves the report. Then the chairman and two other members are escorted by a guard from the board rooms, down the hall a hundred feet and around a corner to a press room partly filled with telephones and telegraph instruments. Here representatives of the press, of market exchanges and other interested groups are waiting. Copies of the report are placed, face down, near each telephone and telegraph instrument. At a signal from a representative of the office of the Secretary, a mild form of pandemonium breaks loose, as each reporter starts giving out the news.

Need for haste has been lessened somewhat by a new rule that closes grain and cotton exchanges for a short period, starting fifteen minutes before the report is released. This gives everyone in the trade more of an even break. After the first release of the report, the board chairman and other members go to a local broadcasting station and send the report out over the radio to millions of farmers and other interested persons.

AS FOR the farmer, his direct benefits include information that will guide him in increasing or decreasing the amount of wheat or corn or potatoes he will plant, or the number of hogs he will raise; and suggestions as to holding or selling particular products. Then, indirectly, crop and livestock reports prevent the distribution of inaccurate, false, or misleading statements by speculators and others; reduce speculation tendencies; help railroads and other transportation companies in knowing how much hauling equipment to provide, and where; and result in better distribution of farm supplies and equipment.

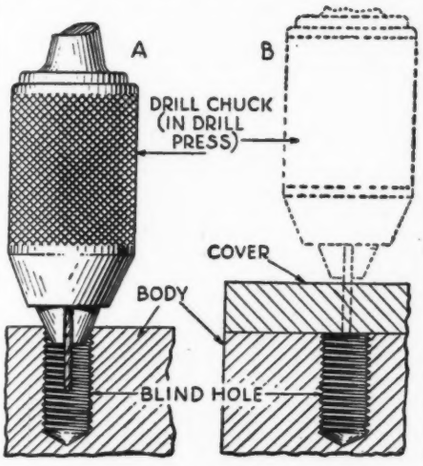
One circus studies farm and crop reports before it maps out its summer travels, thereby making sure that it will visit the most prosperous farm communities. Many banks use the reports as a basis for anticipating demands for loans from farmers. Manufacturers and sellers of farm machinery and equipment employ the reports for allocating their products, so that there will not be a shortage of some items during harvest seasons. Railroads distribute their cars in a similar manner. One large automobile manufacturing concern uses crop reports as if they were maps to buried treasure—to locate areas where farmers have money that they may invest in automobiles.

ONE of the largest soap manufacturing companies studies hog and cotton reports for the purpose of mapping out its raw-materials purchasing program. Advertising agencies direct their campaigns into districts where reports indicate there is a demand for products concerned. Families desiring to move to new territory study reports to learn where the type of farming they wish to follow may be most profitable.

And so it goes. Uncle Sam has good reason for operating his giant news-gathering system—a system whose traffic is so important that automatic printing machines are too slow to be used in relaying messages; in surrounding the activities of more than 2,700 of his employees with such secrecy that not even the Secretary of Agriculture can learn what the periodic crop and livestock report contains until the moment it is released; and in guarding the activities of his crop reporting staff while in session, with severe rules and special mechanical devices for eliminating the possibility that information will leak out and create havoc with food prices, or affect the incomes of thousands of persons who grow things for a living.

TRANSFERRING LOCATION OF BLIND HOLES

IT IS a tricky operation to transfer the locations of blind holes from one part to another part that has to be drilled to match, but there is one simple method anyone can use. First, clamp the piece with the blind hole, or holes, to the drill press table. Then, with a small drill gripped

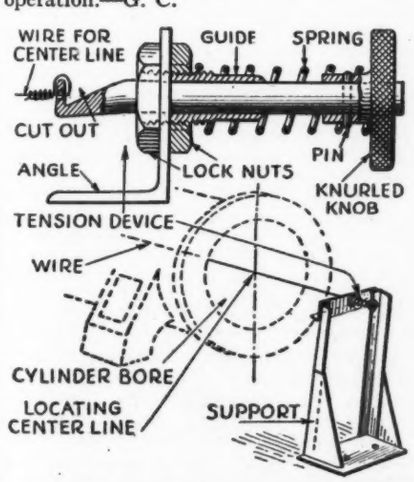


A small drill is centered in the blind hole and then used as at *B* to drill a pilot hole

in a friction chuck, center the hole beneath the drill by using the jaws of the chuck as shown at *A*. Now raise the spindle and put in position the piece to which the location of the hole is to be transferred, and drill it with the small drill. I have used this method successfully for transferring the holes from cylinders to new covers, for making templates, and for similar types of work.—W. H. MOORE.

TENSION DEVICE KEEPS STEEL WIRE TAUT

WHEN machinery is being erected, the device illustrated below will hold a steel wire taut so that center lines can be accurately determined. It can be used for many purposes, but was designed especially for locating the center line of a steam engine cylinder. The perspective sketch shows a stand made for this particular operation.—G. C.



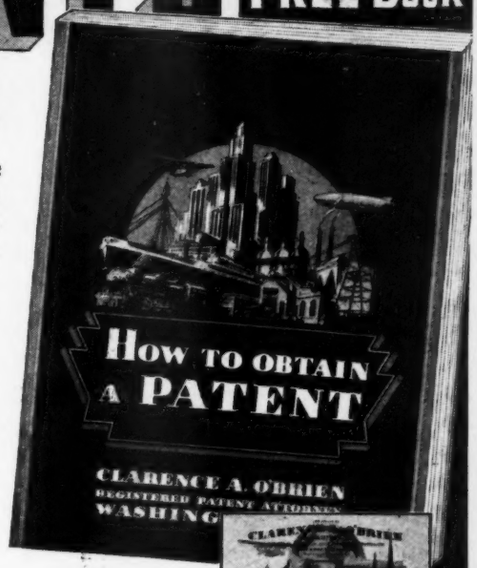
Center lines can be run more accurately if the wire is stretched taut with this device

PATENTS and TRADEMARKS

INVENTORS *Get this* FREE Book

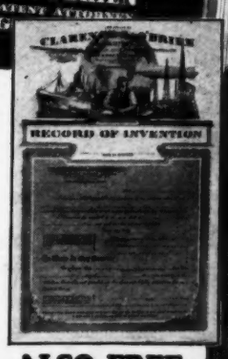
Patent Your Ideas
Free Book Shows How

YOUR idea for a practical article or an improvement upon an old one should be patented NOW. Frequently many of the thousands of applications filed in the U. S. Patent Office each year are for the same or almost the same idea. In such a case, the burden of proof rests with the last application filed. Sometimes a delay of even a few days in filing the application means the total loss of the patent. Lose NO TIME.



The entire time of my large and experienced organization is devoted exclusively to patent and trade-mark cases. We know the rules and requirements of the Patent Office. We understand the technicalities of Patent Law. We can proceed in the quickest and safest ways in preparing an application for a patent covering your idea.

The book shown here contains valuable information that every inventor should know. It tells you just how to go about obtaining a patent for your idea. With the booklet I will send you my "Record of Invention" form on which you may sketch your idea and establish its date before a witness. If a dispute arises this will be valuable to you. Send the coupon TODAY! You will receive the FREE book, the "Record of Invention" Form, and full information regarding costs.



ALSO FREE

"Record of Invention" Blank: On request I will send you FREE a copy of my "Record of Invention" blank. On this blank you can sketch and describe your invention and have it witnessed in such manner that it may be of value to you as evidence. Send coupon now and receive this form together with my free book.

Strict Secrecy Preserved

All communications, sketches, etc., are held in strictest confidence and protected by steel files. Your idea will be in trustworthy hands. I have the highest references. It is probable that I can help you. Send the Coupon AT ONCE.

Personal Service

Your case will be handled by a specialist selected for knowledge and experience in certain lines of inventions. His personal attention will be given to your idea.

CLARENCE A. O'BRIEN
REGISTERED PATENT ATTORNEY
WASHINGTON, D. C.

Clarence A. O'Brien
Registered Patent Attorney
88-T Adams Building, Washington, D. C.

Please send me your Free Book, "How to Obtain a Patent," and your "Record of Invention" form, without any cost or obligation on my part.

NAME .....

ADDRESS .....

.....

(Important: *Write or print name plainly.*)

Works at Home
Makes up to
$125 a Week

$48.40 a Day
Actually Possible
IN THIS AMAZING NEW FOOD BUSINESS

$1.95 INVESTMENT BRINGS $12.80 CASH

NO CANVASSING
(Stores do your selling for you)
NO WAITING
(Start making money the first hour)
NO STUDYING
(Experience absolutely not needed)
NO FAILURES
(A simple machine does the whole job)

Start Your Own Business

Do like Winther did. (See photograph above.) He lost his job—couldn't find work. Started in this sensational new business and is making money hand over fist. Inside 90 days averaged as high as $125 a week!

A wonderful new machine, invented by Chicago food specialist turns out the most surprising food you ever tasted—an amazing new kind of potato chip. Taking public by storm. Instant taste appeal. Great repeater. Wonderful health food. Swamps competition. Cooked by this revolutionary new process, $1.95 worth of raw materials makes $12.80 worth of chips. One machine can actually earn $48.40 daily on wholesale business only.

Costs Nothing

To get full facts. Here's an amazing profit opportunity for men who can see big money in enormous volume of small sales. Quick success possible anywhere—big city or small town. Start at home in space 52 x 20 inches. We furnish everything—machine, recipes, all equipment, automatic sales plans. Show you how to make big money first week and build permanent business quick. No experience needed. Free book tells everything about this surprising and absolutely new business. Write or wire today.

A. H. Adams, President
Vita-Seald Potato Chip Co.
Dept. S-1814, 500 N. Dearborn St., Chicago, Ill.

50 MEN

Winther is not the only man who has made big money with this amazing new food machine. 50 men in different sections cleaning up. Some making only $50 or $60 a week. Others as high as $150 and more. Get the facts now. All FREE. No obligation.

New CORONA
Model No. 3
at NEW LOW PRICES

NOW
$34.90 or
On Easy Terms
Only 10c a Day after 10 Day Trial

SEND NO MONEY

Only a very limited number of these *Brand New* Coronas available at this *Special Low Price* and *Easy Terms*. Don't wait. Get a wonderful nationally advertised Corona at a *real bargain*. Up-to-date improvements and carries our regular New Machine guarantee. Offer good only while supply lasts.

Sent on 10-Day Trial—Fully Guaranteed
ACT AT ONCE—Send coupon for full 10-days' trial. If you decide to keep it send only $3 a month until the special low price of $38.90 (term price) is paid.

Over 100,000 Satisfied Users

International Typewriter Exchange (Corona Division) Dept. C-207
231 W. Monroe St., Chicago.

Send the Corona F. O. B. Chicago for 10-days' trial at the special low price offered. If I am not perfectly satisfied I may return it Express Collect. If I decide to keep it, I will send $3.00 a month until I have paid $38.90 (term price) in full.

Name ..... Age .....
Address .....
Town ..... State .....
Give Reference .....

PATENTS—TRADE MARKS
All cases submitted given personal attention by members of the firm.
Information and Booklet Free
LANCASTER, ALLWINE & ROMMEL
PATENT LAW OFFICES
815-15th St. N. W. Suite 413, Washington, D. C.

OLD WORDS GET NEW MEANING IN QUEER TRADE LINGOES

(Continued from page 29)

a hole of smaller diameter in order to restrict the flow. Later when the well stopped flowing, we started pumping it, but it filled up with sand."

The lingo of the oil fields is rich in terms describing every operation and piece of apparatus used. In many cases these slang terms seem to be the only ones in existence, for they are used in the trade journals and reports of oil well operations.

The assembly of pipe connections and valves at the top of the casing of a flowing well is concisely summed up as "The Christmas Tree." To drain off water or impurities at the bottom of an oil tank is to "bleed" it. A "fish" is anything lost in the hole which must be extracted or evaded. To "get a bone" is to encounter hard rock in drilling. To "skid the rig" is to shift the derrick for drilling a new hole when the old one cannot be continued. The "stool-pigeon" is an instrument recording the weight supported by the derrick in the hole—and hence a "detective" showing how many feet are drilled in a day.

Miners' Terms

COAL mining would seem to be somewhat related to oil drilling, yet its assortment of trade words is entirely different.

The laborers themselves are often called "muckmen" or "hunkies." They have a hearty contempt for all of the other mine employees who work above ground, and express their supposed uselessness by the epithet, "Company-busters."

The exposed or workable part of a coal vein is called "the face." To enable the miner to get loadable coal easily, he has a machine that cuts away a layer, a few inches in height, from the bottom edge of the face. The fine chips the machine produces are called "bug dust." After the coal is loaded into the wagons, it is drawn to the mouth of the mine along the "dilly road." Water that has leaked into the mine collects in a pit called a "sump" before being pumped out. When a partition is built anywhere in the mine to improve the ventilation it is named a "brattish."

Between the Acts

THE triumvirate that rules the setting of the stage is made up of three potentates, "Carps," "Props," and "Juice." In other words, the stage-carpenter, the property man, and the electrician. Each of these captains has under his command a company of helpers which is known by a name as distinctive as his own. The helpers of "Carps" are called "grips," the satellites of "Props" are named "clearers," and the assistants of "Juice" are labelled "operators."

There is an excellent reason for keeping these terms for helpers distinct, for many of them are "floaters," or transient workers, and the three heads of the backstage arrangements have no time to learn every new assistant's name. "Carps" merely needs to call "Grips, strike!" to have instant attention and obedience from his entire staff. They will set to work at once dismantling the set.

The "grips" will "skate" the "flats" that compose the scene across the floor to the side or back wall of the stage. A similar order from "Props" to his "clearers" will remove the furniture and bric-a-brac from the set. And meantime "Juice" and his "operators" are busy readjusting the "pockets" (floor plugs), "bunches," and "spots" used in the act just finished.

Movie-Studio Slang

WHEN a stage play is put on the film, spoken lines and all, the back-stage lingo of "Carps," "Props," and "Juice" is replaced by the special dialect that has grown up around the technique of making talking pictures.

The set is called a "live stage" when it is enclosed by materials that do not absorb much sound. Where it is necessary to prevent sound being reflected or echoed, a portable wall is used, covered with sound-absorbing material. If it is not intended to be photographed, it is a "gobo." If it is to be shown in the picture when produced, it is a "wild wall" or a "jockey wall."

Off at one side of the set is a sound-proof booth called the "aquarium" in which terminates the circuits from the microphones being used on the set. At the controls of a piece of apparatus in the "aquarium" sits the "mixer," or "monitor man," derisively called a "dial twister." He blends the sound coming from the various microphones so that the recording apparatus will receive the proper intensities.

When all tests have been made in the sound-on-film reproducing system, it is reported to be "O. K. on the blops!" And after the sound-on-disc or play back system has been tested similarly, it is reported as "O. K. on the clicks!"

At last all is ready to proceed with the action of the scene being filmed. "Lock 'em up!" is the command. (Close camera booths so all noise will be kept out.)

The next orders are "Down the chute! On the line! Give 'em A. C.!" (Send sound into the amplifier room and switch all recording motors into circuit. Start synchronization of camera and recording motors.)

When the scene has been shot and the "inkies" (incandescent lamps) have been turned off by the "gaffer" (head electrician) and his assistants, the day's film is sent to the developing laboratory for "rushes," or "dailies." In other words the films are developed and printed overnight for trial projection next day.

When a sound film is projected at varying speeds, the interference of the sound waves in the theater auditorium may develop any one of four different defects—"wow-wows," "flutter," "gargle," or "whiskers." Also poorly-made splices in the sound-track of the finished film may cause "bloops." And finally, when the sound-track runs through the pick-up out of line so that a little light passes through the sprocket holes, a disagreeable hum is produced. This is called "sprock."

The trade lingo is simply a habit which is the result of humanity's clan instinct. Every vocation-group feels the need of having its own exclusive patter. Hence it develops a language composed of English words to which it gives entirely new and unexpected meanings.

CHEMICALS TO MAKE IN YOUR LABORATORY

(Continued from page 57)

sulphate or Epsom salts—the same substance used in the beginning—will result.

Many chemicals can be made by immersing a metal in a chemical solution. An iron nail placed in a solution of copper sulphate will become plated with copper. If allowed to remain in the solution for several weeks, all of the copper can be obtained from the solution in the form of a brown powder. The solution, when filtered, contains iron sulphate and can be used as such.

Similar processes in the same way produce other chemicals. The novel lead tree described in a recent issue (P.S.M., Dec. '32, p. 58) yields lead crystals and zinc acetate. Incidentally, lead trees can be preserved as a curiosity by placing a layer of oil on the surface of the liquid to prevent evaporation and exclude the air.

Dry chemicals as well as liquids often react to form new substances. If some powdered lead nitrate crystals, which are white, are mixed with potassium iodide powder, which is white, yellow lead iodide powder is formed. Thorough mixing of the two chemicals can be obtained by placing them in a pill box or stoppered bottle and shaking them vigorously.

When stocking the home laboratory with chemicals, acids should be kept in glass stoppered bottles. With the exception of ammonia water, which should preferably be stored in glass stoppered bottles, most alkalies in solution may be stored in bottles having rubber corks.

If ordinary corks must be used and they are attacked by the chemicals, coat them lightly with hot wax. Glass stoppers that do not fit their bottles snugly can be ground to a perfect fit by placing valve grinding compound on the stopper, inserting it in the bottle neck, and twisting it back and forth and moving it up and down. The compound will wear both surfaces to make a perfect fit.

Many common household substances found in the kitchen and on the medicine shelf can be used by the amateur in his home laboratory. Baking soda, for instance, is chemically known as sodium bicarbonate and can be used as such. Additional everyday substances and their corresponding chemical names are listed on page fifty-six.

NEW TWO-PLY STEEL IS NONCORROSIVE

AFTER several years' research work, a midwestern steel company reports it has succeeded in producing a cheap non-corrosive metal by "laminating" or attaching a thin layer of stainless steel on less expensive carbon steel. Produced by a patented process from a composite ingot, the new two-ply steel can be stamped, welded, formed, and polished, according to the maker, and can be sold at a price that will permit its use where solid stainless steel would be prohibitive in cost.

SUNSHINE SPOILS HAY

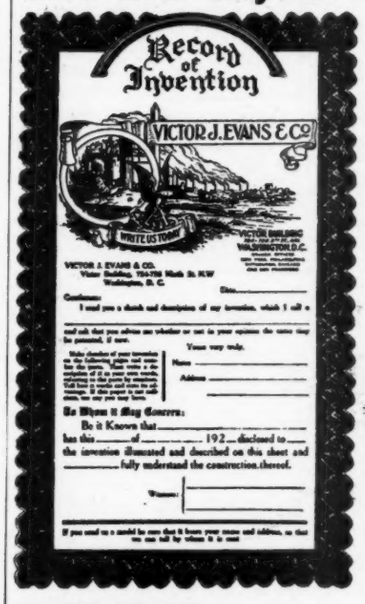
THE proverb, "Make hay while the sun shines," has been amended by Prof. E. R. Hensen, farm crop expert at the Iowa State College. Too much sunshine makes poor hay, he reports. The best results are obtained, his experiments has shown, when the grass is cut in the afternoon and raked into windrows the following morning, as this allows the curative processes to proceed more effectively.

15,000 WEATHER TERMS

FIFTEEN thousand weather terms have been compiled by the U. S. Weather Bureau. They include five hundred names for winds and thirty for hurricanes.

Delays May Be Costly
PATENT
Your Idea Now

Little Ideas May Have Big Commercial Possibilities


Record of Invention
VICTOR J. EVANS & Co.
WRITE US TODAY
VICTOR J. EVANS & CO.
Victor Building, 734-736 Mach. St. N.W.
Washington, D. C.
Gentlemen:
Your very truly,
Name
Address
Be It Known that
has this ..... of ..... 192... disclosed to .....
the invention illustrated and described on this sheet and
..... fully understand the construction thereof.
Witness:

FREE . . . .

VALUABLE RECORD OF INVENTION BLANK

Mail the coupon today, and in addition to the free book, we'll send you without charge a Record of Invention Blank. This form, when properly filled out may be of value to you as evidence should occasion require it. There is no charge or obligation for this service. Mail the coupon NOW.

Don't Lose Time—Send For Big FREE BOOK

ACT AT ONCE—and protect your idea. Remember, to get the benefits of your invention, you not only have to invent it—you have to PATENT it. Many men spend years perfecting an invention, only to find that someone else thinking along the same lines has already received a patent on the idea. When we think of all such cases that have come under our personal observation, we cannot urge too strongly that you take steps to protect your idea IMMEDIATELY. Delays of only a few days may be vitally important to you. Do not lose all the benefits of your hard work in planning and perfecting your invention.

Mail the Coupon for FREE Book Today

It is of tremendous importance that you file your application for a patent at once. Our free book tells you how to proceed, what you need to know about patents in general and gives you an estimate of our reasonable fees. We also send you a "Record of Invention" blank free. Take the first step toward getting your patent now. Mail the coupon at once. If you send along a sketch and description of your invention, we will promptly write you what, in our opinion, ought to be done in order to protect it, and for which service there will be no charge.

Highest References—Strictest Secrecy 33 Years of Proven Service

The members of the firm of Victor J. Evans & Co. are registered Patent Attorneys. Our legal and technical forces include lawyers, registered patent attorneys, patent draftsmen and searchers. Our Patent Office and Federal Court practice is confined to patents and trademarks. We specialize in these two subjects to the exclusion of all others. In our 33 years of patent practice, we have successfully served thousands of inventors to whom we can refer. It is a distinct advantage to an inventor to employ an attorney located in Washington as the U. S. Patent Office has no branches.

Here's How We Operate

As soon as the description of your invention comes into our office, it is immediately put in charge of an attorney, who is particularly familiar with the kind of invention you have perfected. Under his close personal supervision, patent searchers and skilled draftsmen work. He personally sees your case through to its conclusion. In short, you have the advantage of highly skilled and experienced service. Reasonable charges. Deferred payments.

Here's What the Coupon Brings. Mail It Now

Mail the coupon today and take the first step toward protecting your idea. You will receive the FREE Book, a FREE Record of Invention Blank, and information on our fees. You create no obligation by mailing this coupon. Our service is complete, our fees reasonable, and our terms convenient. Don't waste priceless time: mail the coupon NOW.

MAIL THIS TODAY

VICTOR J. EVANS & CO.

Established 1898

REGISTERED PATENT ATTORNEYS

MAIN OFFICE 646-BB, Victor Building, Washington, D. C.

BRANCH OFFICES: 1640 BB Conway Building, **Chicago;** 233 BB Broadway, **New York;** 828 BB Fidelity Philadelphia Trust Building, **Philadelphia;** 514 BB Empire Building, **Pittsburgh;** 1010 BB Hobart Building, **San Francisco.**

Please send me your free book, "How to Obtain a Patent," and your "Record of Invention Blank."

Name.....

Street and No.....

City..... State.....

WANT A STEADY JOB?

Railway Postal Clerks

$158 to $225 a Month
MAIL COUPON BEFORE YOU LOSE IT

Short Hours — No Layoffs — Many Other Future Government Jobs MEN—WOMEN 18 to 50

FRANKLIN INSTITUTE, Dept. F-281
Rochester, N. Y.

Sirs: Rush to me without charge—copy of 32-page book, "How to Get U. S. Government Jobs," with list of future positions and full particulars telling how to get them.

Name .....
Address .....

INVENTORS
PATENT YOUR IDEAS

Write for Free Book, HOW TO OBTAIN A PATENT and RECORD OF INVENTION—or send drawing or model for examination. MAIL COUPON TODAY!

MILLER & MILLER, Patent Attorneys
FORMER MEMBER EXAMINING CORPS U. S. PATENT OFFICE
1006 Woolworth Bldg., Dept. C, New York
205 EARLE BUILDING WASHINGTON, D. C.

Please send me your Free Book, "How to Obtain a Patent," and your "Record of Invention Form."
Name .....
Address .....

RE-TREADS TIRES as low as 75¢

AGENTS UP $6 an Hour

SPREAD-A-TREAD patches a worn spot for a few pennies. Re-treads entire tire as low as 75c. Anyone can do it. No tools needed. Spreads on with a knife. Dries overnight. Tough, flexible, long wearing. 2,000 additional miles guaranteed. Ends costly re-treading or vulcanizing. Saves buying new tires. Helps prevent blow outs. Rush name and address for Free Sample showing toughness. Get special agents offer showing how you can make up to $6.00 an hour. Write
PLASTIC RUBBER CO. OF AMERICA
Dept. A-315 E. Court St., Cincinnati, Ohio

UNPATENTED IDEAS CAN BE SOLD

I tell you how and help you make the sale. Free particulars. (Copyrighted)
Write W. T. Greene
921 Barrister Bldg. Washington, D. C.

"How To Write For the MOVIES and TALKIES"

is the name of a book by a successful playwright—(Author of Flight, etc.)—and Famous Director. It will be sent you FREE for the asking. It tells how producers are clamoring for short stories, new ideas, plots, etc., which perhaps you can write—and we can help you shape and sell. One of our writers (V. M.) received $3,000. We made 6 sales in 1 day recently. New York best market. Demand active now! Try your hand! Send name for FREE Book.
DANIEL O'MALLEY CO., INC.
Suite 51-D 1776 Broadway, New York City

Inventions Promoted

Patented or Unpatented. In business over 30 years. Send drawing and description or model, or write for information. Complete facilities. References.

ADAM FISHER MFG. CO.
183-D Enright, St. Louis, Mo.

High School Course in 2 Years

You can complete this simplified High School Course at home inside of two years. Meets all requirements for entrance to college and the leading professions. This and thirty-six other practical courses are described in our Free Bulletin. Send for it TODAY.
AMERICAN SCHOOL
Dept. H-248 Drexel Av. & 58th St. © A.S. 1923 CHICAGO

PATENTS SECURED
Trade-Marks Registered

I offer you the advantages of my 35 years experience as a patent lawyer and assure you of personal attention to your business.
TERMS REASONABLE.
Book and Information Free.
L. F. RANDOLPH
340 Victor Building Washington, D. C.

BECOME AN EXPERT
ACCOUNTANT

Executive Accountants and C. P. A.'s earn $3,000 to $15,000 a year. Thousands more are needed. We train you thoroughly at home in spare time for C. P. A. examinations or executive accounting positions. Previous bookkeeping knowledge or experience unnecessary. Training given by C. P. A.'s. Write for free book, "Accountancy, the Profession That Pays," and learn about opportunities in this growing, profitable field.
LaSalle Extension University, Dept. 283-H, Chicago
The School That Has Trained Over 1,100 C. P. A.'s

INVENTORS who derive largest profits know and heed certain simple but vital facts *before* applying for Patents. Our book *Patent-Sense* gives those facts; sent *free*. Write LACEY & LACEY, 635 F St., N.W. Dept. 10, Washington, D.C. Established 1869

VOICE

100% Improvement Guaranteed

We build, strengthen the vocal organs—*not with singing lessons*—but by fundamentally sound and scientifically correct *silent exercises* . . and absolutely *guarantee* to improve any singing or speaking voice *at least 100%*. . . . Write for wonderful voice book—sent free. Learn WHY you can now have the voice you want. No literature sent to anyone under 17 unless signed by parent.
PERFECT VOICE INSTITUTE, Studio 13-62
308 No. Michigan Ave., Chicago

"Our Readers Say" is getting to be one of the most diverting and interesting features in the magazine. If you have not written in to the Editor of "*Our Readers Say*" why not break into print with some idea that you are interested in. Your letter will be welcome.

FREE LESSON
Home Art Craft

GOOD MONEY FOR SPARE TIME

A new easy way. Art novelties in big demand. Get free lesson and quickly learn to decorate Gifts, Bridge Prizes, Toys, etc. No experience necessary. Anyone can succeed with simple "3-step" method and you earn as you learn. Everything furnished including supply of Novelties for you to decorate and Homecrafters Outfit.

NO CANVASSING

Just sit at home and make up to $50 a week spare time or full. Write today for big, illustrated book and FIRST LESSON FREE. Absolutely not one cent to pay. Lesson is free. Openings in every locality. Write quick.
FIRESIDE INDUSTRIES
Dept. 51-B, ADRIAN, MICH.

Photography for PLEASURE or PROFIT

A fascinating hobby or a profitable business can now be yours. Prepare quickly at home under the personal guidance of leading experts in the fine art of photography. No experience necessary. Full or spare time. Many earn while learning. Our thorough studio method also qualifies you to fill a well paying position upon graduation. Send coupon below at once for FREE booklet, *Opportunities in Modern Photography.*

AMERICAN SCHOOL OF PHOTOGRAPHY
3601 Michigan Avenue Dept. 1362 Chicago, Ill.
Send booklet, *Opportunities in Modern Photography*, and full information.
Name .....
Address .....
City ..... State .....

WHAT TO DO WHEN BRAKES WON'T HOLD

(Continued from page 62)

from the bench and examined it. "It seems to me automotive engineers ought to be able to perfect some sort of brake lining that won't wear out," he said. "They make bearings that outlast a car."

"Bearings and brakes are two different things," Gus reminded him. "In a bearing, we try to reduce the friction between the parts by using a lubricant. With a brake it's just the reverse; we want as much friction as we can get and wherever you have friction, you're bound to have some wear. Your brakes were lubricated and the friction was reduced. That's why they didn't hold.

"I can give you a heavy lining that'll wear like iron," Gus said as he lifted a roll of fabric from the stock shelves, "but you won't like it. Hard linings are noisier than soft ones. We use this heavy lining on trucks."

"SHOULD brake linings be set at any definite clearance from the drums?" Rankin asked.

"External brakes will bind if they're set up too tight," replied Gus. "The heat generated by friction causes the brake drum to expand. On internal brakes, it's a little different, since the expanding drum moves away from the linings and increases the clearance. Internal brakes can be set up a little tighter than external brakes."

"I've never had much luck trying to reline my own brakes," Rankin confessed as he watched Gus equalize the brakes with a portable hand tester that clamped to the rim of the wheel. "I suppose I never learned the knack of it."

"It's easy when you know how," chuckled Gus, "but it's a trick not many car owners know."

"The thing not to do is crowd the lining too much when you apply it. After I've relined a set of brakes and adjusted them, I drive the car for a few hundred feet in second gear with the brakes partly on. That helps to smooth out the lining and forces it into place. Then I readjust them, if it's necessary.

"When you're adjusting mechanical brakes don't touch the linkage unless you have to. That'll be set right when you buy the car. On most brakes, the cranks and pull rods should be at right angles when the brakes are fully applied; that gives the greatest possible leverage."

"That reminds me," Rankin interrupted. "Ken Doyle, next door to me, says you should always have two or three people in a car when you make any brake adjustments. Is there anything to that idea?"

"That's a good thing to do sometimes," Gus agreed. "You see, on some cars, the rear axle may shift a trifle when the car is loaded and that upsets any adjustment made when the car is empty. By working with an average load, you can get an adjustment that will be fairly good for all conditions."

"How quickly should you be able to stop with four wheel brakes?" Rankin asked when Gus had completed the job.

"Well," Gus replied after a moment's consideration, "you ought to be able to stop your car easily in about twenty-five feet when you're going twenty miles an hour. Trouble is, most people don't pay enough attention to their brakes to have them work that well. If they did, you wouldn't read about so many accidents.

"The average person thinks more about color schemes, horse power, and cigar lighters than he does about brakes. Take my advice, Ned, and test your brakes as faithfully as you change the oil in your motor. You should never forget that your brakes are the main safety feature on your car."

The Salvation Army Slogan During The Past Months Has Been

Hunger Knows No Holiday

FOLLOWING a Winter during which greater demands than ever before were made upon the organization by the poor and needy, the war against poverty and distress was resolutely carried on from over 2,000 centers throughout the Summer. Thousands of homes were saved from disaster . . . .

DURING THE PAST YEAR OVER FIFTEEN MILLION APPLICATIONS FOR ASSISTANCE WERE MET

AGAIN Winter comes with increased cries for aid from the victims of unemployment and other ills. The Salvation Army forms the shock troops of social welfare. It meets the first impact of human need. Its capacity for succor lies in the generosity of its friends . . . . . .

HELP US TO THE LIMIT OF YOUR ABILITY

Mail Your Contribution Today To:

COMMANDER
EVANGELINE BOOTH
NATIONAL HEADQUARTERS OF
THE SALVATION ARMY
120 West 14th Street
New York, N. Y.

or, if you prefer, to your local resident officer. Gifts may be allocated to any specific purpose or district.

BE A JAZZ MUSIC MASTER

Play Piano By Ear

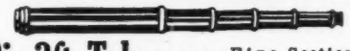
Play popular song hits perfectly. Hum the tune, play it by ear. No teacher—self-instruction. No tedious ding-dong daily practice—just 20 brief, entertaining lessons, easily mastered.

At Home in Your Spare Time

Send for FREE BOOK. Learn many styles of bass and syncopation—trick endings. If 10c, (coin or stamps) is enclosed, you also receive wonderful booklet *"How to Entertain at Piano"*—and many new tricks, stunts, etc.

Niagara School of Music
Dept. 700, Niagara Falls, N. Y.

Send for this Free Book



Big 3ft. Telescope Five Sections. Brass bound. 10-Mile range.

Study Moon, Stars and distant objects with this powerful 8-X instrument. Special Eye Piece for viewing Sun, included FREE. Makes an ideal microscope. Guaranteed. Big value. Postpaid $1.75. C. O. D. 15c extra.

BENNER & COMPANY, T-69, TRENTON, N. J.

FORMS TO CAST LEAD SOLDIERS, INDIANS, TRAPPERS, Hunters, wild and Farm Animals. 222 Wonderful "True to Life" models. Easy and inexpensive to make. I furnish all necessary material. Send 6c Stamp for Illustrated Catalogue.

Henry C. Schiercke, Ghent, New York

This Book Has Helped Thousands to Success

The Real Estate Educator

The New Revised Edition, contains Questions and Answers; Brokers' License Law; Dictionary of Words and Phrases in Real Estate and Construction; How to Appraise Property; Law of Real Estate; How to Advertise Real Estate; Legal Forms; Commissions to Agents; "Don'ts" in Contracts, etc. 288 pages. Cloth. Postpaid $2.00.

The Popular Science Monthly
381 - 4th Ave. New York

HOW DETECTOR TUBE HELPS RADIO WORK

(Continued from page 61)

this way, the grid voltage, as illustrated at *B* in the drawing on page 61, causes the plate current to decrease varying amounts, as illustrated at *C*.

The action of the grid of the tube thus eliminates one-half of the incoming alternating wave and produces uni-directional variations in the plate current which in turn, by means of earphones or loudspeakers, produce sounds that are accurate duplicates of those entering the microphone at the transmitting station.

IN THE grid-bias detector, no condenser and grid leak are used. Instead, the grid is operated theoretically at such a voltage that with no signal entering the system, the plate current is zero. In other words, the grid is given an initial negative voltage by some outside means that stops the flow of electrons from the cathode when no signal is received to upset the balance.

Since the grid is already negative and no plate current flows initially, the negative alternations of the incoming wave have no effect on the plate circuit. Being zero, the plate current can be reduced no further no matter how negative the grid becomes. The positive alternations, on the other hand, increase the flow of electrons to the plate and thus increase the current flowing in the plate circuit. In this way, the negative half of the incoming alternating wave *A* is eliminated and the positive half produces variations in the plate current in one direction only as at *D*.

So far the consideration of the grid-bias detector has been entirely theoretical. In practice, the grid-bias voltage is made slightly less than the theoretical value so that with no signal entering the circuit the plate current is not actually zero but is very small. The negative half of the wave is then not entirely eliminated but is greatly reduced in comparison with the increases of the positive half. The fluctuations in the plate current of an actual grid-bias detector then take the form shown at *E*.

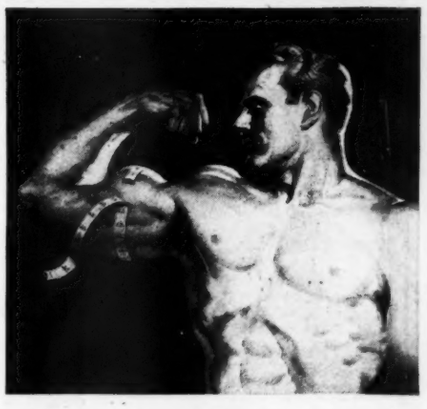
In both the grid-leak and grid-bias detector circuits, the radio-frequencies are bypassed from the circuit by a condenser connected from the plate of the tube to the cathode.

IT IS interesting to note from the plate current curves of the two detector systems that in the condenser-grid leak detector the plate current is decreased from its initial value and in the grid-bias detector it is increased.

In the next article in this series on the fundamentals of radio, the so-called "characteristic curves" of tubes will be discussed.

STRONG INSECT POISON NOW MADE CHEAPLY

A NEW menace to destructive insects is the development by U. S. Department of Agriculture chemists of a means of making synthetic rotenone economically. This poison, described in these pages (P. S. M., Nov., 31, p. 44) was originally made from derris, an East Indian plant, and the roots of cube, a South American shrub. The cost of rotenone, ten to twenty dollars a pound, has been too high to permit its use on a large scale. With the discovery by Doctors F. B. LaForge and H. L. J. Haller, of the Department of Agriculture, of a method of making synthetic rotenone, it is believed that this insecticide will soon be numbered among poisons available to farmers in their war on insect pests.



»I will add 2 INCHES TO YOUR BICEPS

. . . or it won't cost you one cent!"

Signed: GEORGE F. JOWETT

TWO solid inches of tough, sinuous muscle added to your biceps . . . or it won't cost you one penny! That's my unqualified guarantee . . . it means that I'll take you, whether you are big or small, strong or weak, thin or fat, and add two full inches of muscle to YOUR biceps! If I hadn't accomplished this for thousands of others . . . if I wasn't absolutely sure that I could do it for you . . . I wouldn't dare make such a startling guarantee!

You will not only increase your biceps, but every part of your body will be developed proportionately . . . I will add at least 3 inches to your chest . . . I'll give you lithe, muscular legs that will be columns of power for speed and endurance . . . I'll make your whole body vibrate with muscular energy, pep and health!

Take my full course and I will guarantee to add 3 inches to your chest and 2 inches to your biceps or it won't cost you one penny!

Try one of my test courses NOW . . . prove to yourself that you too can get a sixteen inch bicep!

Send for "Moulding a Mighty Arm" A Complete Course for ONLY 25c

It will be a revelation to you. You can't make a mistake. The guaranty of the strongest armed man in the world stands behind this course. I give you all the secrets of strength illustrated and explained as you like them. In 30 days you can get an unbreakable grip of steel and a Herculean arm. Mail your order now while you can still get this course at my introductory price of only 25c.

I will not limit you to the arm. I can develop any part or all of your body. Try any one of my test courses listed below at 25c. Or, try all six of them for only $1.00.

Rush the Coupon Today

Mail your order now and I will include a FREE COPY of **"NERVES OF STEEL, MUSCLES LIKE IRON."** It is a priceless book to the strength fan and muscle builder. Full of pictures of marvelous bodied men who tell you decisively how you can build symmetry and strength the equal of theirs. Reach Out—Grasp This Special Offer.

FREE BOOK WITH PHOTOS OF FAMOUS STRONG MEN

"Nerves of Steel, Muscles like Iron" SENT FREE!

JOWETT INSTITUTE OF PHYSICAL CULTURE
Dept. 29 Pb 422 Poplar St. Scranton, Pa.

George F. Jowett: Your proposition looks good to me. Send, by return mail, prepaid, the courses checked below for which I am enclosing_____

- ☐ Moulding a Mighty Arm. 25c
- ☐ Moulding a Mighty Back, 25c
- ☐ Moulding a Mighty Grip, 25c
- ☐ Moulding a Mighty Chest, 25c
- ☐ Moulding Mighty Legs, 25c
- ☐ Strong Man Stunt Made Easy 25c
- ☐ All 6 Books for $1.00.

Name_____ Age_____

Address_____

Make Beautiful Furniture at 1/10 CABINET WORK STORE COST

Big New 60-Page Catalog E—full of bargains—

Home woodworking book—color illustrations—inlay bandings—scroll patterns—blue prints—various wood grains, crotch, butt, quartered, burl, fiddleback, plain sawn, etc.—tells how to finish woods natural—foreign woods—jig saw puzzles. Articles you can make—desks, tables, book shelves, etc. Send for it today—only 10c, or FREE with $1.00 or more order.

L-112

SOLID MAHOGANY or Walnut 28"

Turned—Fluted and SANDED L-106 **Leg 55¢ Each**

L-106

Craftsman Wood Service Company
We Ship All Over The World
7354 Vincennes Ave. Chicago, Ill.

Master Home Mike

New 1933 Model Complete with Mike Ring and Handle

95¢ POSTPAID

Reproduces your own voice through your radio. Fools your friends. A million dollars worth of fun. Easy to connect. Fits any radio. A real microphone—not a toy. Mailed postpaid, only 95c. Send today.

Master Mike Co., 4612 Grand River, Detroit, Mich.

PRACTICAL RADIO ENGINEERING

New things are happening in radio! Developments! Improvements! Keep up to date, at RCA Resident Schools in New York or Chicago. Illustrated book free.

RCA INSTITUTES, INC.

Dept. PM-2
75 Varick Street New York

$1.00 Jig Saw

"The Puzzlemaker"

Equipped with V-pulley for your treadle or motor. 15" long—9" high. 6½" table. All metal construction. Sent postpaid on receipt of $1.00. (Canada $1.35.) C.O.D.'s 25c extra. *FREE booklet "Make Your Own Jig Saw Puzzles" with every saw.*

J. & H. METAL PRODUCTS CO.,
Dept. 2 490 St. Paul Street Rochester, N. Y.

Get A FLYING START TO SUCCESS IN AVIATION!

With the

THE AVIATION MANUAL

This book will save months of time and hundreds of dollars by giving you a thorough ground training in Aviation. You need it whether you're going to be a pilot, mechanic, radio operator, salesman or executive. The Aviation Manual, with its 700 pages and 250 diagrams and illustrations, covers the whole field so expertly that it will always be a reliable reference book—even long after you've finished your preliminary work!

REGULAR PRICE $5.00— NOW ONLY $3.95

With Your Name In Gold On The Front Cover

Now you may have this beautiful Manual bound in expensive, flexible, fabrikoid, with full gold edges all around for only $3.95 C. O. D. And we will print your full name in gold on the front cover. This is a special temporary price which may be withdrawn shortly. We will refund your money if you return the book within ten days and say you are dissatisfied. Clip and mail the coupon to-day.

Popular Science Publishing Co.,
381 Fourth Avenue, New York, N. Y.

Please send me a copy of the regular $5 edition of the Aviation Manual with full gold edges and my name in gold on the front cover. I am to pay the postman only $3.95 plus a few cents postage when the book arrives. This will pay in full for the Manual. If I am dissatisfied I may return the book within ten days and you will refund my money. (2-33)

Name .....

City ..... State .....

Address .....

DRUGS BRING NEW ERA IN SURGERY

(Continued from page 34)

In the old method of administering ether, drop by drop, on a gauze mask, the evaporation of the volatile fluid often reduced the temperature so much a coating of hoar frost covered the gauze. At the end of the second stage, consciousness is lost, often abruptly.

It is during the third period that the operation is performed. The patient is in a deep sleep. His pulse has increased to between eighty and 100 beats a minute. The pupils of the eyes, previously dilated, have contracted. At this stage, a larger amount of anesthetic enlarges the pupils, a smaller amount contracts them. Breathing is deep, stertorous. *A soft snore is a sure sign of a good anesthetic.*

ELECTRIC anesthetic machines, and batteries of cylinders filled with different vapors under high pressure, are now part of the equipment of many hospitals. Watching the dials, the expert in charge controls the strength and flow of the anesthetic by means of levers. Besides keeping the patient unconscious by replacing the ether lost in breathing, he must watch the type of tissue through which the surgeon is cutting. Some tissues are more sensitive than others and when the surgeon works with them, an extra amount of anesthetic is required to prevent pain and shock.

During this third period, the anesthetist, or expert in charge, must be alert to every danger signal. He watches his patient like a hawk, concentrating upon his pulse, his respiration, his blood pressure, his eyes, and his color.

The patient's color is of prime importance. It indicates whether he needs more or less oxygen in the anesthetic vapor. Jaundiced persons and Negroes, consequently, are difficult subjects for the doctor in charge of the anesthetic during an operation. In Negroes, he watches the lips and the color of the blood at the wound. A special instrument, known as a "haemoxometer," which indicates variations in the color of blood with extreme accuracy, is sometimes employed under such conditions.

Brain operations are also difficult problems for the anesthetist. The face of the patient is hidden by towels. By changes in the shade of the blood or the color under the fingernails, he judges the patient's needs.

I recall one striking case in which a brain operation in Philadelphia, Pa., lasted more than two hours under unusual conditions. At the end, the doctor in charge of the anesthetic was exhausted from the strain.

A middle-aged woman had been strapped upright in an operating chair under the big light while halt a hundred visiting surgeons watched a famous brain specialist demonstrate an innovation in his work. Without disturbing the essential muscles and nerves, he laid back a flap of skin on the scalp and then cut through the bone of the skull, making an opening an inch and a half in diameter. Taking a metal band, shaped like a spoon handle, he inserted it in the opening. All the lights in the room snapped out. The surgeons in the rising tiers of seats leaned forward.

SUDDENLY, there was a dull red glow within the patient's skull. A tiny electric light at the end of the metal band had been switched on, solving the big problem in brain surgery—getting sufficient illumination within the skull. However, all during the operation, the anesthetic expert had to work in practical darkness, unable to see his patient, judging her condition by other indications than changes in color.

A new aid under such conditions is a heart speedometer, an *(Continued on page 103)*

Keep Your Copies of "POPULAR SCIENCE"

In This Beautiful New Binder

There is so much useful information in Popular Science Monthly that many readers have asked us to supply them with a binder in which they can keep a permanent file.

To meet this demand we have had designed a beautiful binder. Bound in deeply embossed Artcraft (looks like leather—lasts forever) with the name of the magazine and cameo design stamped in 24 Karat Gold on the cover. This binder will securely hold 6 copies of Popular Science Monthly.

New copies can be slipped into the Big-6 Binder as easy as inserting a letter in an envelope.

There is nothing to get out of order—no screws to work loose, no keys to get lost. This binder will last a lifetime.

The binder is as beautiful as it is useful—it will be an ornament to any library table.

Only $2.00—Postage Prepaid

Bought in a store this binder would cost you $3.00 or more. Because we are having them made in quantity for our readers we can make you the special price of $2.00 including all delivery charges.

Popular Science Monthly, 381 Fourth Avenue, New York, N. Y.

Please send me your Big-6 Binder bound in deeply embossed Artcraft with "Popular Science Monthly" richly embossed on the cover in 24 Karat Gold. I am enclosing $2.00 and it is understood that there is to be no further charge of any kind. (2-33)

Name.....

Address.....

.....

It's Easy To Make Big Spare Time Money

Send for our free plan on how to make $5.00 to $15.00 a week in your spare time by taking orders for POPULAR SCIENCE MONTHLY from your friends. No selling required. Turn extra hours into extra dollars.

POPULAR SCIENCE MONTHLY
381 Fourth Ave., New York, N.Y.

Please send me full information free on how I can make big money in my spare time.

.....
(Name)

2-33 .....
(Address)

DRUGS BRING NEW ERA IN SURGERY

(Continued from page 102)

instrument known as a cardiotachometer, which has been invented by Dr. Ernst P. Boas, of New York City. It amplifies the beating of a patient's heart 6,000 times and gives instant warning of the approach of a crisis.

The fourth stage in an anesthetic by ether is fortunately rare. It is the stage of the overdose, when the patient reacts unfavorably. A thready pulse, feeble, uneven breathing, and dilated pupils which do not contract when exposed to light, are the danger signs. The anesthetic is instantly stopped and stimulants are applied.

ONE of the first signs of recovery from an anesthetic is a slowing down of breathing. The rate often drops to twenty inhalations a minute and sometimes less. As consciousness returns, the odor of the ether on the patient's breath usually causes vomiting. Gauze soaked in vinegar, essence of orange, or other aromatic oils, is often placed under the nose on the upper lip to kill the ether odor. In some hospitals, the fumes pass through containers of such volatile oils and reach the patient with a pleasing scent. This is not necessary with nitrous oxide, for it is practically odorless and has a pleasing sweetish taste suggesting burned sugar.

In Akron, Ohio, a few years ago, a spark from an X-ray machine touched off an explosive mixture of ether in an operating room. The blast shattered part of the apparatus but, fortunately, injured no one. Because ether is highly explosive, special precautions are taken in all operating rooms. Mercury switches prevent sparks; metal strips in the floor carry off static electricity; chains from the legs of the operating tables and anesthetic machines ground them to the steel of the building.

Ether is two and a half times as heavy as air, so during an operation it descends and forms a thin blanket along the floor where explosions are likely to occur. Ethylene, a new anesthetic gas which is increasing in popularity because it produces a deep sleep lasting longer than that resulting from laughing gas, is also highly explosive.

One of the most important recent innovations is spinal anesthesia. Neocaine, a French drug, is injected into the lower spine, deadening the abdomen and lower extremities, while the patient retains full use of his arms and is perfectly conscious, sometimes reading a newspaper or listening to a radio while the operation is in progress.

DURING the past three and a half years, one Brooklyn, N. Y., surgeon has performed more than 3,500 operations using this type of anesthetic with remarkable success. It eliminates nausea after the operation and there is no excitement stage as there is with ether.

It was in Brooklyn that one of the queerest happenings ever reported from an operating room occurred recently when a patient on the operating table sounded a fire alarm! He was looking out the window when he saw flames in another wing of the building. A waste basket had caught on fire. His quick warning resulted in speedy work that kept the blaze from spreading.

Two new anesthetics which have been introduced only recently are avertin and pernocton. Avertin is given by rectal injection and is particularly useful for short operations. It acts quickly and the effects are all over in an hour. Pernocton is taken by mouth or injected into the veins. It puts the patient into a deep sleep which lasts for several hours, during which time a major operation can be performed.

Avertin was the anesthetic used with remarkable success in the recent operation upon Henry Ford, the famous automobile manufacturer, in Detroit. Because it imposes a minimum of strain upon the heart, the new drug was selected by Dr. Roy D. McClure, Head of the Ford Hospital and the surgeon who performed the operation for appendicitis and strangulated hernia. After the operation, which required forty-minutes, the progress of the sixty-nine-year-old industrialist was highly satisfactory. In less than the usual time he was able to leave his bed.

Local anesthetics are now being used frequently in major operations. Novocaine (one-seventh as dangerous as cocaine), eucaine, and benzyl alcohol are finding wide favor among surgeons. In skull surgery, local anesthetics are often employed in place of ether. They deaden the skin and flesh where the incision is made. After the bone is reached, there is no sensation of pain.

Not long ago, a Long Island physician was injured in an automobile crash. A bone splinter, an inch long and half an inch wide, had to be removed from the base of his brain. All during the operation, which lasted forty-five minutes, he retained consciousness, discussing the various steps of the work with the surgeon.

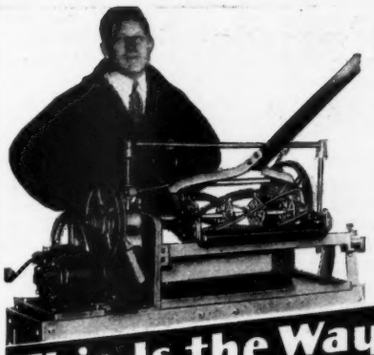
The most remarkable use of a local anesthetic in major surgery was the operation which Dr. Evan O'Neill Kane performed upon himself. This famous surgeon had operated upon nearly 4,000 appendicitis cases when he, himself, was attacked. Sitting on the operating table, propped up by pillows, he swabbed the right side of his abdomen with iodine and alcohol and then injected novocaine from a small hypodermic syringe along the line he intended to cut.

WITH a steady hand, he made the incision, removed the appendix, placed the purse-string stitch of catgut around the stump and pulled it taut. He was out of the hospital, following the operation, in less than the usual time. His experiment, he pointed out, demonstrated that when the system is not burdened with a general anesthetic recovery is hastened.

The newest local anesthetic is diothane, recently discovered by Dr. T. H. Rider and E. W. Scott, two Cincinnati, Ohio, chemists. It is said to deaden pain longer than either novocaine or cocaine and yet has no habit-forming properties. Because of the slowness with which the anesthetic disappears after an operation, it keeps the patient comfortable longer than is usually the case. The new drug is closely related to a number of similar organic anesthetics which are not particularly effective. The potency of diothane is said to be accounted for by a few slight changes in the position of the atoms in the chemical compound.

Eighty-seven years have passed since Morton demonstrated to the doctors of Boston the magic power of ether fumes. During those decades, medicine has traveled far on the road to painless surgery. The safety and effectiveness of anesthetics have increased many-fold. Month by month, surgeons report new feats which add fresh chapters to this thrilling story of conquering pain in the operating room.

NEXT MONTH Dr. Damrau will tell the amazing story of the human carpentry that takes place in the modern operating room. He tells of living bone grafted from one part of a patient's body to another; of severed arteries sewed together; of paralysis cured by surgery. Watch for the March issue, out February 1.



This Is the Way To Make MONEY!

That is what hundreds of men are saying about the Foley Electrakeen Lawn Mower Sharpener business they have started. Last year Woodmancy earned $25 to $30 a day. Morse earned $1520 in five months.

Start Your Own Cash Business at Home Now

There is no other method for sharpening lawn mowers to compare with the Foley. You can turn out perfect work quickly and easily. Simply put the lawn mower in the machine and turn on the power—the Foley Electrakeen System automatically sharpens ALL blades at once.

Foley Electrakeen Lawn Mower Sharpener

Uses same system as the leading lawn mower factories. Sharpens all sizes and types of lawn mowers. Costs you only 1c a job and you get $1.00 to $1.50. New attachment also grinds axes, hatchets, knives, etc. Walter Dambek writes, "I purchased a Foley Electrakeen Lawn Mower Sharpener three weeks ago and have already made enough money to pay for the machine and all expenses. . . ."

Big Profits Can Be Earned

There is plenty of business waiting for you. People would rather have their lawn mowers sharpened the Foley way because they cut better and stay sharp longer. YOU can start this business in spare time and make BIG MONEY! Small investment—easy monthly payments—Spring will soon be here—There will be lots of business for you—Send coupon or postcard today—no salesman will call.

Send for Complete Information *Today*

Foley Manufacturing Co.

208-3 Foley Bldg., 11 Main St. N. E., Minneapolis, Minn.

Tell me how I can start my own Cash Business and make Big Profits with the Foley Electrakeen Lawn Mower Sharpener.

Name .....

Address .....

City ..... State .....

SECRET SERVICE BOOK FREE

Sent

For 20 Days Reading—No Money Down

Actual Crime Cases—*If You Act Quick!* We will send you this stirring book on Crime Detection, Secret Service and Identification Work for 20 days free reading. Send no money. If you decide to keep it, then send me only $1. If not, return it. WRITE TODAY. Not sent to boys under 17 years of age.

T. G. Cooke, Book Dept. 13-62 1920 Sunnyside Ave., Chicago, Ill.

New Ideas now Salable Before Patenting

Have you a sound, practical invention for sale, unpatented or patented? If so, write

Chartered Institute of American Inventors

564 Barrister Building Washington, D. C.

"World's Largest Organization of Inventors"

Transatlantic Air Line Links Two Continents

(Continued from page 15)

floodlights at the airport at Cadiz, eighty miles up the Atlantic coast from Gibraltar, fourteen hours after the takeoff in Berlin.

There the Bathurst plane is warmed up for its 1,800-mile dash southward across Africa. Leaving at sunrise, it sweeps down the Spanish coast, out over the Rock of Gibraltar and the narrow entrance to the Mediterranean, and begins the lonely flight across mountainous Morocco and the wastes of the western Sahara. All day long, hour after hour, it rushes through the sky above desert sand, rolling and monotonous. Toward evening, the Senegal River winds across its path. Tangled jungles are now below. Three hours later, the lights of Bathurst appear in the dusk. The plane slips down with throttled motors to a landing on the floodlighted field. It has been in the air eighteen hours in one stretch.

FOR the ocean leg of the journey, winged boats produced by the famous Dornier factory are used exclusively. The first machines put in service will be twin-engined Dornier "Whales." Later, it is planned to substitute giant twelve-engined DO-X models, fitted with special staterooms and Pullman beds for passengers.

The twin-engined machines have the motors placed in tandem above the high monoplane wing, one pushing, the other pulling. In the hull, below the wing, immense gasoline tanks hold sufficient fuel to drive the two 400-horse-power engines for nearly fourteen hours. With throttles wide open, the Whales will rush through the air at more than two miles a minute.

Both on tropical airways and in northern Siberia, these sturdy machines have demonstrated their endurance. A remarkable example is the old Dornier-Wal, D1422, which recently was retired from service and placed on exhibit in the museum of Munich, Germany.

It began its career in 1925 above the Arctic ice when Roald Amundsen and Lincoln Ellsworth tried to fly to the North Pole. Two years later, Capt. Frank T. Courtney, the British war ace and test pilot, used it in an attempt to fly the Atlantic from east to west, starting from the Azores. Finally, in 1930, the veteran of the air carried Wolfgang von Gronau and his companions on their pioneer flight from Germany to America, in which they followed the trail of the Norsemen, flying by way of Iceland, Greenland and Labrador. After seven years of exploring uncharted skyways, D1422 was still flying when it was retired from service.

Before daylight the next morning, the Dornier is packed with mail and express, ready for the takeoff. At the nose of the long hull, the pilot sits behind a control wheel. In front of the cockpit is an empty anti-collision chamber to reduce the hazards of a head-on smash. Just back of the pilot is the radio room. Here the operator, with his 2,500-mile short-wave transmitter, and his receiving set, will keep in touch with the shore and the *Westfalen* during the flight. Back of the radio room is the mail and express compartment and back of it a storage space for extra gasoline supply and motor oil.

WITH idling engines, the plane swings slowly out to sea. The pilot opens the throttles. His speed increases. There is a flash of spray, a dizzying rush of water and the craft is in the air. The ocean drops away. Rapidly, the coast line recedes into the morning mist. The plane is over the sea heading for a tiny 400-foot island floating in mid-ocean, nearly a thousand miles away!

On the top of the white hull is something looking like a barrel hoop standing upright and pointing straight ahead. It is the loop antenna of the radio compass. Like a bloodhound's nose, it will lead to the goal, following the radio waves coming from the *Westfalen*.

The strength of the signals received depends upon the position of the loop, which can be moved on a vertical axis. When it is edgewise to the direction from which the signals come, the volume is greatest; when the opening of the loop faces the direction of source, the volume is least. By adjusting the loop to keep the signals at their maximum volume, the radio operator guides the boat through the sky to its moving target.

This route over the ocean will slice across the Equator from twelve degrees north, the position of Bathurst, to eight degrees south, the position of Pernambuco. From time to time, the radio man passes up weather reports. All are favorable. Only small tropical showers, that pound on the seventy-four-foot wings and the hull of the boat for a few minutes and then are gone, break the monotony of the flight.

A little after noon, the pilot sees far in the distance, a toy ship trailing a faint black thread of smoke. Behind it, appears a tiny white blotch. It is the *Westfalen* with the drag sail ready. The vessel is heading into the wind. The plane comes down in a long slant, skims over the water, slows down in a cloud of spray, and slides up on the canvas without a jar. Mechanics, clambering on the wing, attach the hoisting cable and it is pulled slowly to the deck. The first half of the sea flight is over.

Less than half an hour later the Dornier is refueled, tuned up, and on the launching rails of the great catapult. Before a row of gages the man in charge of the 150-foot air-gun stands ready. With racing engines, the pilot signals for the start. An instant later the big plane whizzes down the steel track as though shot from a giant sling. One breath-taking rush and it is in the air. In five minutes the *Westfalen* is again a toy ship.

A little after two in the afternoon the craft passes the Equator. From then on until dusk it plows straight ahead for the Brazilian coast. Near sunset it passes three or four vessels steaming slowly across the water below. But darkness falls before the island of Fernando Noronha, the first point of land met on the westward passage is sighted. It is nine o'clock when the cluster of lights marking Pernambuco appears dead ahead and the pilot dips downward and plows to a stop in the bay. He has crossed the Atlantic in slightly more than eighteen hours. By catching the night plane for the south, passengers can reach Rio de Janeiro by mid-morning and complete the 6,000-mile air journey from the capital of Germany to the capital of Brazil in less than three days.

THE trip in the reverse direction, crossing the Atlantic from west to east, takes from half a day to a day longer. Near the Equator, where the ocean crossing is made, trade winds blow steadily from the east, speeding up planes flying west and slowing them down flying east. This is exactly the reverse of conditions over the North Atlantic.

The first pilots who bridged the South Atlantic on wings all made the westward passage to get full advantage of steady tail winds.

It is interesting to note that the first machine to blaze an air trail from Europe to South America was an early model of the Dornier-Wal, the type of ship to be employed on the new airway. In 1926, Capt. Ramon Franco and three companions flew from Spain to Buenos Aires, taking two weeks for the journey and making frequent stops. The takeoff of the historic flight was made from the very bay of Huelva out of which Christopher Columbus, 434 years before, had sailed in his *Santa Maria* on his voyage to the New World.

The first non-stop crossing came in October 1927, five months after Lindbergh's dash to Paris. With one companion, the famous French flyer, Capt. Dieudonne Costes, left St. Louis, Senegal, Africa, and headed his Breguet land plane southwest over the Atlantic, landing nineteen hours and twenty minutes later at Natal, Brazil.

In the two years after Costes' exploit three pilots flew non-stop from Europe to South America. Two started from Seville, Spain, while the third, Major Carlo del Prete, took off from Rome, Italy, remained in the air fifty-one hours and fifty-nine minutes, and covered 4,450 miles before he brought his record-breaking monoplane to earth at Natal.

The most careful survey of conditions over the ocean airway between Africa and South America was made during the past two years by the *Graf Zeppelin*. Under the direction of Lufthansa officials this famous German dirigible made ten round trips between Friedrichshafen and Brazil. During the previous summer it had crossed the South Atlantic six times.

From these pioneering flights information was gathered which will be of value to the daring men who lead the way on a regularly-scheduled transatlantic air service. When the *Santa Maria* of this service, the first Dornier-Wal, takes off and heads out to sea, it will mark an important step toward dramatic possibilities which lie ahead.

Rest Chair for Movie Stars

Movie stars must rest between scenes despite tight gowns that can't be sat down in without disaster. This ingenious rest chair is the solution of the problem